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SUNLIGHT AND SHADOW.

From the Oil Painting by George Fredericks.

THE WAVERLEY
NATURE BOOK

A POPULAR DESCRIPTION BY PEN AND CAMERA OF THE DELIGHTS AND BEAUTIES OF THE OPEN AIR

VOLUME VI

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A WINDING STREAM IN THE NEW FOREST.

LIFE IN THE NEW FOREST—II

By F. MARTIN DUNCAN, F.R.P.S.

Illustrated with Photographs by the Author

ALTHOUGH the New Forest is probably better known to the entomologist than to the lover of bird life, the birds of the Forest are very numerous and interesting, for out of the 354 species which are natives or visitors to England, nearly 200 frequent the Forest. From April to July a glad and ever-increasing flood of song resounds through the Forest from dawn to sunset, while, borne on the wings of the soft night wind of June, comes the sibilant song of the Night Jar, or Night Hawk as the forester generally calls it. This strange churring, ventriloquial note is one of the familiar Forest sounds in the dusk of a warm summer's night. Keeping close cover during the hours of daylight, as the twilight deepens into dusk, the Night Jar may be seen swerving and wheeling with great activity and in perfect silence, in pursuit of the insects on which it feeds. One curious trait which helps this beautiful and interesting bird to escape detection, is its habit when alighting on the bough of a tree to rest with its body placed along the bough, and not at right angles to it, as is the habit of most birds. This peculiar habit, coupled with the soft tones of its beautiful plumage, makes

the Night Jar a very difficult bird to watch.

Formerly the Kite, the Honey and Common Buzzard, and the Hen Harrier frequented the Forest, but now, I am afraid, that but for a rare and very occasional, single visitor, they can be no longer counted amongst its feathered inhabitants. The extinction of the Honey Buzzard was undoubtedly hastened by the professional collector, who remorselessly sought for the eggs. It is sad to think that a similar fate must inevitably overtake many interesting and beautiful birds who still make their homes within the precincts of the Forest, unless something is very promptly done to put a stop to the present persecution during the breeding season.

One curious and interesting point in connection with the extinction of the Kite and Hen Harrier, is the remarkable increase in the number of small birds within the Forest; and, probably also thanks to the absence of their feathered foes, many of these birds are becoming wonderfully bold and confiding. Therefore, although one must needs regret the extinction of the noble Kite and Harrier, there is solace in the fact that their absence from the Forest enables one to watch the ways and manners of many a small bird who formerly could only be kept under observation with great difficulty.

As the nesting season advances, there comes from many a bush, and tangle of bramble and bracken, the faint shrilling trill of the baby birds, whose appetites seem to be insatiable. Very gently parting the branches and peeping in, we catch a glimpse of the long, scrawny necks, and quivering heads with eager, gaping beaks, of the unfledged nestlings. Sometimes the sound is stronger and more insistent, and then we may find the nest filled with the spacious form of a full-fledged young cuckoo who a few hours after its birth ousted the rightful inhabitants, and now claims the unremitting attention of their parents, who seem well-nigh distracted by the unceasing demands of their foster-child for food.

THE NEST IS FILLED WITH THE SPACIOUS FORM OF A YOUNG CUCKOO.

A PAIR OF YOUNG LAPWINGS.

The Forest is watered by many pleasant winding streams that are fairly well stocked with fish, and are the haunt of the Kingfisher, who may frequently be seen perched upon some bough that projects across the water, from which coign of vantage it dives to capture its prey, or flies swiftly away if alarmed at our approach, giving us but a momentary glimpse of its exquisite plumage. These streams in passing from the woodland across a belt of open country, widen out and flow between low reed-bordered banks, beloved of the Heron, who may often be seen standing alone, grey sentinel on the shallow margin of the stream.

Out on the lonely marshlands of the Forest, with its dangerous, quaking bogs, we hear the plaintive "pee-e-wit," "pee-e-wit" of the Lapwings, as those beautiful birds, alarmed at our approach, rise and circle above our heads. It seems a sad pity that this graceful and useful bird—it is truly one of the best friends that the farmer possesses—which at one time was common on all the open lawns and spaces in the Forest, is now practically confined to the wildest plains and dangerous marshes, owing to the ruthless manner in which its eggs have been collected during the breeding season. The baby Lapwings are the most delightful, soft, downy little creatures, their markings and colourings so closely resembling the brownish-grey tint of the marshland that, as they huddle close to the ground at the approach of danger, it is practically impossible to detect their presence. The mother bird at your approach stealthily creeps away from her young, and then rising, circles round your head, giving vent to her plaintive cry, and with a tumbling flight, as if cramped or wounded, strives to lead you from her nest or young, her mate joining with her in her frantic endeavour to draw your attention away. Once alarmed it is a long time before the parent bird will return to her eggs or young, and if one would see her settle on her eggs or brood her young, one must exercise some patience and craft. By lying flat amongst the growth of heather and reeds, and very quietly and gradually drawing under the shelter of a bush, we may be able to watch the precautions of the mother bird, who has been alarmed at our approach, ere she returns to her young. After circling in the air for some time, giving vent to her shrill, plaintive cry, to which her mate responds, she will at last settle on the ground and, with her quick, characteristic, running gait, move from place to place on the marsh, giving every now and then a faint, low call. At last, if her fears are allayed, she will draw near to where her young are hiding, and then crouching on the ground, will call her chicks to her; and, with the aid of the field glasses, we may see the tiny, downy youngsters hastily run up and hide themselves beneath the snow-white plumage of their mother's breast. She then gives a series of calls of satisfaction, and her mate, satisfied that all is well, moves off and away in search of food.

In April, when the foresters are in the

full swing of stripping the oak bark, the loud and oft-repeated call of the Wryneck sounds through the woods; and the men, as they pause in their work, tell each other that the "Rinding Bird" has arrived. This bird, with its delicate, pencilled, grey-brown plumage, has many a popular name besides its forest one of "Rinding Bird," in some counties being known as "April Bird," "Cuckoo's Mate," or "Snake Bird." "Rinding Bird," "April Bird," and "Cuckoo's Mate" are all names which have to do with the season of its arrival; whilst "Snake Bird" and "Wryneck" tell of two peculiar characteristics: one of the vigorous hissing noise which the sitting bird makes when disturbed; the other of its habit of twisting its long flexible neck into all sorts of odd contortions. On account of the wonderful way in which its mottled plumage harmonises with the bark of the branches amongst which the bird delights to hide, the Wryneck is a most difficult bird of which to obtain a good sight. It builds no regular nest, but contents itself with slightly enlarging a suitable hole in the trunk of some tree in the Forest, particularly the stunted thorn tree, and forming just a slight layer of soft rotten wood at the bottom of the hole, upon which it lays its glossy, white eggs. A

A YOUNG WRYNECK AWAITING THE RETURN OF THE PARENT BIRDS.

FOREST PONIES.

little later in the season we may catch a glimpse of a full-fledged nestling peering out from the nest, with craning neck and anxious expression, awaiting the return of the parent birds with food.

Echoes down the long dark glades the hoot of an owl, and in the gathering gloom we catch a glimpse of a large bird as it passes swiftly on broad and silent wing. In an hour the moon will rise, and then we may hear the Tawny Owls call to each other across the lawns. It is astonishing, in the deep quiet of the forest night, how far the hoot of the owl carries. The owls are fairly numerous, and one rarely takes an evening walk without being rewarded with the sight of at least one of these birds starting forth on its nightly foray. During the nesting season they become very bold, and even aggressive, as the ardent entomologist has learned to his cost on more than one occasion when sugaring for moths at night. The parent birds, alarmed by the flashing of his lantern for the safety of their young, will swoop down and attack him with beak and claw.

While the Tawny Owls frequent the forest glades, loving to nest in the hollow of some ancient tree, the Barn Owls keep more to those districts that are under partial cultivation.

As we pass along the sandy bank of an enclosure facing south on a warm sunny autumn morning, we may catch sight of an adder sunning itself at the entrance to a deserted rabbit burrow. This is a very favourite situation with the adders, and a good number seem to hibernate during the winter in the deserted rabbit burrows in the sand banks that face the south. Far from being an aggressive creature the adder is only too anxious to get away if disturbed, and generally will only show fight when cornered, or when trodden upon—an accident which may happen when one is tramping through heather.

Very beautiful is the coming of spring in the Forest, a sight the memory of which will ever remain a cherished treasure in the mind of the lover of Nature who has looked upon it. Here, indeed, one can realise the full beauty and significance of the old Greek Nature myths. All through the long dark nights of winter, have we not heard the voice of Demeter, sighing and calling through the leafless branches of the forest trees, seeking vainly for her vanished child? Look! a golden star amidst the whirl of the restless wind-blown leaves—a single Celandine flower, bringing its promise of good to come. Now in the hazel-wood blossoms the Primrose, lifting a golden chalice, fragrant with hope, to the fitful gleam of the cold

THE BARN OWL.

March sun. Soon the Violets begin to show in the woods, and the air grows sweet with their breath. Already the woodland path is clothed with the white stars of the Windflower, forming a carpet for the dainty footsteps of Persephone.

Yes! from the underworld Persephone returns, and at her coming the whole forest mantles with delicate green. Down the long leafy aisles comes the glad song of the throstle, bringing Tennyson's beautiful lines to our mind:

"Summer is coming, summer is coming,
I know it, I know it, I know it.
Light again, leaf again, life again, love again,
Yes, my wild little Poet."

And so with the advent of May the Forest bursts into the full glad tide of early summer. F. MARTIN DUNCAN.

CHAPTERS IN PLANT LIFE

V—THE PLANT AND ITS HELPERS

By S. LEONARD BASTIN

With Photographs by the Author

IN the fierce battle of life there is small chance for the exercise of charity. We have no evidence to show, apart from certain instinctive traits, that one being ever helps another unless something is given in return. The plant, owing to the many inherent disadvantages under which it exists, is sorely in need of helpers to enable it to carry out the functions which it is bound to perform. Yet surrounded as it is on every side by enemies, it has not been an easy matter to enlist the services of those who are in a position to lend their aid. To this end some of the more ingenious devices in the vegetable kingdom have been brought into being, and there are few more interesting phases of plant life than the relations of the plant and its helpers.

Although the question is one concerning which there is a great diversity of opinion, it seems almost certain that plants benefit by the cross-fertilisation of their blossoms. It is not easy to avoid the conclusion when one considers all the marvellous arrangements which have been entered into, presumably with this object in view. The fact, too, that in so many cases the male and female organs in the flower mature at different times suggests that self-fertilisation is not wanted. Not the least amazing feature is the variety of the agents which are induced to help the plant in the distribution of its pollen. Insects, spiders, birds—even the wind and water—act as emissaries in this marriage of the plant. The intricacies of some of the relationships are so astonishing that it must always be a matter for

STINKING GLADWIN (*IRIS FŒTIDISSIMA*), A WELL-KNOWN BRITISH PLANT WHICH HAS AN UNPLEASANT SMELL ATTRACTIVE TO CERTAIN INSECTS.

conjecture as to how such things could come about.

Overshadowing all else in connection with the cross-fertilisation of flowers is the work accomplished by insects. It will be no exaggeration to say that hundreds of thousands of species embracing nearly all classes are actively engaged in pollen transference, although it is likely that the insects are in total ignorance of the services which they render. It is evident that it is necessary for the plant to offer some inducement, so that it may appear to be worth the while of the unwitting helper to visit the flower. In most cases this attraction is to be found in the nectar which the blossoms secrete, and this will act as a never-failing bait to draw the insects into making a call. The nectaries themselves present a variety of forms, sometimes appearing as sunk glands, on other occasions being grooved, whilst again they may resemble small warts. These processes are, as well, placed in different parts of the flower—in the Japanese Lily they exist as grooves on the perianth, whilst in the Buttercup we may find them at the base of the petals. Even the essential organs themselves are nectary bearers, as is to be seen in the case of the shortened stamens of the Cuckoo Flower, and the ovaries of the Antirrhinum and Veronica.

The showy flowers of the Grass of Parnassus are of special interest, from the

fact that in the centre of each bloom an arrangement of five hairs gives rise to a curious illusion. Each of these processes presents the appearance of being tipped with a shining drop of nectar, although, as a matter of fact, the flower is quite devoid of honey. Anyone who cares to watch the flowers of this charming bog plant on a fine summer day, will see that a large number of flies are deceived into the belief that the glistening points will yield them some reward if they visit the flower. The little insects seem to be quite disgusted when they discover that the feast of honey which they had expected to find does not exist at all. Yet the clever plant has achieved its object in drawing the attention of a visitor who will be likely to aid in the dispersal of the pollen.

It seems almost certain that in not a few cases the pollen itself is offered as an inducement to the insect to visit the flower. There is little doubt that large numbers of small beetles, which in one way may be regarded as robbers, act as the agents for the carrying of the pollen from one bloom to the other. This is easy to understand in the case of those plants which produce pollen largely in excess of their actual needs. An observer has been at pains to count the number of grains produced by the flower of the Hibiscus. It was estimated that sixty grains would be amply sufficient to fertilise all the ovules of the blossoms,

SIDE VIEW OF THE FLOWER OF *ARISTOLOCHIA GIGAS*, SHOWING THE TORTUOUS PASSAGE IN WHICH THE FLIES ARE ENTRAPPED.

whereas in a normal case the stamens were responsible for five thousand. Even this number is small compared with the quantity of pollen grains produced by the Dandelion, estimated at nearly four hundred thousand; whilst in the case of the Pæony the number has been placed at between three and four million!

There is no doubt that insects are often attracted to flowers by their appearance and scent. Many blossoms advertise their presence by the gay colours which they display and the sweet perfumes which they exhale. Almost all kinds of flies are very prone to settle on anything which is strikingly marked, and not a few plants have turned this tendency to account. The observations of many students of this particular phase of plant life have gone to show how gaily coloured flowers receive first attention. It has also been demonstrated that certain insects are attracted by a particular colour, and choose this in preference to others. Thus, from the experiments of Lord Avebury it appears that bees will, if there should be any choice in the matter, select the blue flowers, while flies seem to be more partial to those of a yellow or brown tint.

POINSETTIA PULCHERRIMA, FROM SOUTH AMERICA.
The bracts surrounding the insignificant flowers are flaming crimson in colour.

Many species with insignificant blooms have called to their aid showy bracts to advertise the presence of their flowers. Of these, the South American Poinsettia is one of the most striking examples. In this case the true flowers are unattractive and would certainly never be noticed on their own merits. However, the flaming red bracts which encircle the small blossoms are so imposing that there are few more striking sights than the Poinsettia in perfection. In the same way the Bougainvilleas have emphasised their small dull yellow blossoms by encircling them in three bright pink bracts. As a result this plant is quite one of the most showy features of the tropical forests.

Many flowers are favoured with attention owing to the resemblance they bear to some object which the insect is likely to regard with favour. Nearly all flies are fond of visiting rotting meat or similarly offensive matter, and this tendency has been taken advantage of by many plants. The simulation is kept up, both in the appearance of the bloom and in the smell which it emits. The British Field Iris has been called the "Roast Beef Plant," owing to the curious odour which the flower gives out, although the smell is scarcely so appetising as that of the cooking joint. A Southern European Arum (*A. dracunculus*) is so offensively scented that the plant is hardly a fit subject for culture in the garden. Moreover, the tinting of the flower is of a lurid brown colour, not unlike the colouring of rotting meat. Most remarkable of all, however, are the South American Aristolochias, plants mostly producing huge flowers coloured in brown and white. The form of the flowers of these Aristolochias is also very singular, and in one species long portions trailing away from the body of the bloom give the impression of drippings from a

large piece of meat. As well, the flowers of the Aristolochia emit a horrible odour, which is so nauseating that a person cannot stay long in the vicinity of a blossom. That this simulation is not in vain, may be gathered from an examination of the interior of the bloom, which is crowded with flies come in search of the imagined dainties.

Having attracted the insect to the flower, it is necessary to make sure that it does not go away without its burden of pollen. In almost every case of a flower fertilised by insect agency, the pollen grains are either sticky or else covered with excrescences which cause them to adhere readily to any object. As a curious contrast, the pollen produced by wind-fertilised plants is almost always smooth and free from any projections. With a large number of flowers, especially in the case of the Compositæ, the insect visitor in his wanderings brushes up against the anthers of the stamens, and in this way becomes dusted with the pollen, which is likely to be carried to the next bloom visited. The Peacock Butterfly, which sips nectar from the clustered bloom of the Scabious, cannot fail to get a certain amount of pollen over his legs and body. In like manner the bee which blunders into the Crocus blossoms will, both at her entry and exit, be certain to have her body freely powdered with the golden dust.

In such cases as these we see the relations of the plant and its insect helper at their simplest. Far more elaborate arrangements have been devised to ensure the effective distribution of pollen by insect agency. Many of these are especially remarkable owing to the fact that the flower is designed for the visits of one class of insect, or perhaps for a single species. Thus a number of exotic plants which are introduced into British gardens can never be effectively cross-fertilised, simply because none of our indigenous insects is fitted for the task. A rather curious case is that of a Brazilian species, *Araujia albens*, a plant which is of fairly easy culture in the south of England. In its native country the cross-pollination of the *Araujia* is carried out by large humble-bees, strong enough to force their way in and out of the curious trap-like contrivance which guards the pollen masses. In other places, however, where the plant has been introduced, the flowers are largely visited by moths, which, unaware of the curious device, thrust in their probosces in search of the nectar. Too late the unfortunate insects find that they are caught in a trap from which they have not sufficient ingenuity to release themselves. So they flutter away their lives in vain endeavours to escape.

Undoubtedly the largest number of special arrangements in flowers have been made with a view to the reception of bees. However these extraordinary relations have arisen, the plant could scarcely have secured a more industrious and systematic worker. It has been computed that an average bee will visit three or four hundred blossoms on a summer day, so that even where flowers are in great profusion we may take it that not one will escape attention from the winged visitors. The way in which many flowers have been specially designed in order to keep out unwanted callers has been dealt with elsewhere, but it is interesting to consider the ease with which the right visitor can obtain an entrance. Most people must have watched a humble-bee open that "strong box," the Antirrhinum flower. How convenient is the little platform on which the insect may alight and secure a firm hold with her legs in order that the contrivance may be forced open!

Even as the bee takes her measure of the nectar, she receives a dusting of pollen from the anthers. More ingenious still is the arrangement in the case of the Pea. In this flower the stamens and pistil are contained in a process formed by two petals joined together, generally spoken of as the keel. At a certain stage in the development of the blossom, the anthers discharge their sticky pollen into the cavity at the tip of the keel. Now it is just at this time that the Pea makes its greatest effort to attract attention; the standard is fully spread, the fragrance given out is at its strongest, whilst the supply of nectar is all in readiness for the expected visitor. At last the bee alights, taking up its position on the two lateral petals while

it prepares to feast at the banquet. The weight of the insect at once depresses the keel of the flower, and the style, being a fixture, is forced through the hole at the end of the process. Now the end of the style has been provided with a brush, and this in its passage through the conical part of the keel becomes plentifully laden with pollen. Naturally the underneath part of the bee is well dusted with the yellow grains, and the stigma of the next flower the insect calls at will be certain to receive a share of pollen from the last bloom visited. By an equally ingenious device the Sage blossom ensures that the bee shall not fail to act as an agent for the transmission of its pollen to another flower. Here, again, we find a convenient little platform on which the insect may alight. As is the case in so many flowers, the anthers and the stigma mature at different times. The stamens of the Salvia are arranged in the form of a very curious contrivance. Two of the anthers are quite rudimentary; but the others, instead of being affixed to the filament of the stamens in the ordinary way, are arranged on a connective in the form of a swinging rod. When the flower is ready for the reception of the insect the movable rod is in an upright position.

PASSION FLOWERS ARE LARGELY FERTILISED BY HUMMING BIRDS.

Now the nectaries are situated deep down in the flower, and the bee in her search for the sweet stuff must needs come in contact with the terminal knobs of the connective. Thus the rod is forced round, and the anther lobes at the other extremity deposit their pollen upon the back of the insect. The style of the Salvia is in the hood-like portion of the flower, and until its time for maturing arrives it is comparatively short; as its development proceeds, however, the organ extends downwards. If the next Salvia blossom visited by the bee should be in the female state, the stigma will be in just the position to meet the back of the insect which has previously been dusted with pollen. In this way the cross-fertilisation of the flower is secured.

In considering the question of cross-fertilisation by insect agency special attention must be directed to the Orchids. If it can be contended that complication of design is typical of a high order, then we must place the flowers of these strange plants in the forefront. The very formation of the Orchid blossom is so intricate that it is not at all an easy matter to distinguish the different parts.

In the typical Orchid flower we find three fairly distinct sepals, although even here the two lateral ones are sometimes joined together over the interior part of the flower. The petals are also three in number, one of them frequently being much larger than the others, and forming a curious pouch which projects well forward. Even the essential organs have undergone some remarkable modifications, so that it is quite impossible to recognise any stamens as such, the pollen being produced in two bag-like contrivances which are united to the stigma. As might be expected, the means by

which the cross-fertilisation of such a complicated flower is carried out present many points of interest. The story of the cross - fertilisation of the Early Purple Orchis (*Orchis mascula*) is one of the most fascinating in the world of plants. An examination of the flower will show that the petal forming the lip is carried backwards into a spur which, although it contains no nectar, is valued as a food substance in itself by bees. Now the head of the insect in search of the succulent tissue comes into contact with two sticky discs attached to the stalks of the pollen masses; so that when the bee emerges the pollinia are carried away.

THE POLLEN MASSES MAY BE REMOVED FROM THE FLOWER OF THE PURPLE ORCHIS ON THE POINT OF A PENCIL.

At first the pollen masses stand erect, but in about half a minute, owing to a beautiful arrangement whereby the base of the stalk contracts, they incline forward. Thus by the time the bee has arrived at the next flower the pollen masses are in such a position that they cannot fail to strike the stigma. The manner in which the pollen masses are attached to the head of the bee may be well seen if the point of a pencil is inserted into the cavity of an orchid flower, and then gently drawn away.

It is not always that the plant, after attracting the insect to pay a visit, is willing to let the creature take its departure at once. In the case of *Aristolochia clematitis*, gnats and other insects are sometimes held prisoner for sixty hours until the work which is required of them has been performed. The essential organs are contained in a kind of bulbous swelling at the base of the flower, to which entrance is only possible through a narrow tube. This passage way is lined with stiff bristles pointing downwards, through which the incoming insects are easily able to force their way.

When the flies arrive the stigmas are in readiness to receive the pollen which the visitors will bring with them; meanwhile the insects are regaling themselves on the tissue which forms the walls of the apartment in which they are really prisoners. When they think they would like to depart and make attempts to fly up the tube, it becomes evident that no escape is possible through the hairs, which completely bar the way. It is not until the end of three days that the anthers have come to perfection, and the flies in their frantic efforts to escape become well dusted with pollen, that the barrier dries up and the captives are allowed to go on their way.

Among our hedgerow plants the common Cuckoo Pint is an interesting study of the way in which insect visitors are held captive. Without pulling aside the greenish spathe of the arum it is impossible to see the true flowers, which are clustered round the base of the upright column called the spadix. At the bottom of all are to be found the female flowers, and just above them is the ring of male blossoms. Higher still we find a mass of hairs pointing downwards. The ovary-bearing blossoms mature first, and at that time give out rather an unpleasant odour which is peculiarly attractive to flies. The insects arrive in numbers, many of them well dusted with pollen from other arums which have been visited, and find it an easy matter to go down through the palisade of hairs. After visiting the female flowers, each of which produces a drop of honey, the little visitors do not find it such a simple business to escape upwards through the

array of hairs. Indeed, it is not until the stigmas have withered, and the anthers have come to perfection, dusting the flies with pollen, that the fringe of bristles dries up and allows the flies to go about their business once more.

It is known that humming birds play a considerable part in the fertilisation of many tropical American plants. By their peculiar habit of flight, these little birds are well adapted for hovering over blossoms and sipping the nectar from the blooms with their long beaks. A great variety of flowers appear to be visited by these tiny creatures, although they seem especially to favour the blossoms of the Fuchsia and Lapageria, as well as some of the Passion Flowers. In Britain a large number of our trees are cross-fertilised by the agency of the wind, and in no cases are the blossoms large or gaily coloured. Most people must be familiar with the long hanging catkins of the Hazel, which as they reach their maturity are among the first signs of approaching spring. These are, of course, only the male organs of the plant, and it requires some searching to find the clusters of crimson threads which represent the stigmas. On a day when the anthers have come to perfection the smallest puff of air blows the pollen in little clouds through the leafless branches, and a certain amount of it is sure to find a resting place on the female organs and in this way to bring about pollination.

THE NECTARIES OF THE CUCKOO FLOWERS ARE AT THE BASE OF THE TWO SHORT STAMENS, WHILST THOSE OF THE BUTTERCUP ARE AT THE BOTTOM OF THE PETALS.

The Scots Pine presents a most striking example of a tree which relies upon wind fertilisation. In the month of June, when the anthers arrive at maturity, we may see the pollen hanging over the branches in dense clouds. The dispersal of the grain from the male flowers to the undeveloped female cones is facilitated by the fact that the pollen is provided with minute wings. At the time when the pollen floats away on the breezes the ovules on the female cones exude a sticky substance, which ensures the retention of any grains which happen to come in contact with it.

A certain number of plants rely upon water as a medium for the distribution of their pollen. Of this a British marine species, the Grass Wrack, is an example. The pollen grains are here of tubular form, and being of like specific gravity to the water, are conveyed by the currents from the anthers of the male flowers to the stigmas of the female organs. More strange still is the story of the Italian Eel Grass (*Vallisneria spiralis*), a native of Southern Europe. The male and female flowers are produced on different specimens, and at first both kinds are developed low down, quite close to the roots of the plant.

As soon as the female blossoms have nearly matured, however, the long stems on which they are borne (previously packed away in a receptacle) unwind and bring the flower heads to the surface. At this time the submerged male buds become detached and rise to the surface. After a short interval the blossoms open back three sepals, and in this way form a kind of raft upon which they can float about, driven in all directions by the wind. Sooner or later the majority of the little boats will be certain to come to a halt against one of the female blossoms, with the result that the projecting stamens can discharge the pollen grains upon the waiting stigma. After fertilisation the long stalk of the female blossom coils up spirally, and gradually carries the ovules down to the mud bottom, where the seeds may ripen in safety. S. LEONARD BASTIN.

THE MOLE CRICKET.

THE CRICKETS

THE FIELD CRICKET THE MOLE CRICKET THE HOUSE CRICKET

By DOUGLAS ENGLISH, B.A., F.R.P.S.

With Photographs by the Author

THE Crickets, who are represented by four species in this country, present features of such interest and novelty that it is hard to account for the indifferent attention which they have received from British authors. Little has been added to our knowledge of their life habits since White, of Selborne, wrote of them in 1778. He devoted three letters to a description of the three species known to him, and would no doubt have added a fourth had he been acquainted with the scarce Wood Cricket. These letters (XLVI.—XLVIII.), which are written with characteristic simplicity and directness, give one the impression that the Field Cricket, Mole Cricket, and House Cricket were in White's time comparatively common in the neighbourhood of Selborne. It is true that of the Field Cricket he says, "Though frequent in these parts it is by no means a common insect in many countries," but he makes no comment on the distribution of the Mole and the House Crickets beyond noting that the latter resides "altogether within our dwellings," and that the former often "infests gardens by the sides of canals." That White took great interest in the Field Cricket is shown by the fact that he made more than one ineffectual attempt to transplant individuals from "Short Lithe" to his own garden; he had excellent reasons for preferring

to study the Mole Cricket in other people's gardens.

"Short Lithe" is described in Letter XLVI. as a steep, abrupt pasture field interspersed with furze, consisting of a rocky dry soil and inclining to the afternoon sun.

It would need but slight modification to make this description strictly applicable to the locality where I first heard, and soon afterwards first saw, the Field Cricket.

Let the reader picture a sun-burnt, grassy slope, fringed on its summit by a coppice, and with its surface broken here and there by stunted brambles. Half-way up it he might, on the occasion referred to, have seen a crouching figure, bent almost double, working stealthily upwards, tip-fingered and tip-toed, searching the ground with infinite precaution, now pausing rigid as a stone, now slowly stretching out a hand to part a grass tuft. The Cricket hunter must go slow. He must let neither flicker in the grass nor whisper in the air escape him. Above all, he must know what to look for. Apart from the welcome sound of stridulation, there are certain definite signs which in time lead him to his quarry. Field Crickets are solitary insects, and reside in burrows of their own making. From these during the daytime they seem never to move more than a few inches, and their feeding on the grass and roots in the immediate vicinity (Mr. O. H. Latter, to whom I owe my first introduction to Crickets at large, informs me that they are especially fond of the "bulbs" of the bulbous buttercup) often results in the presence of a bare patch of soil, two or three inches square, immediately before the burrow entrance. A stridulating Cricket is usually about half-way out of his hole, presenting his back to the landscape. A Cricket who is sunning himself, or lying in wait for smaller insects (Crickets by no means confine themselves to a vegetable diet), faces outwards, or, it may be, climbs a few inches up the neighbouring grass stems. In either case the slightest vibration will send him backwards or forwards down his burrow.

Field Crickets breed in the warm summer months. I have never witnessed courtship in the case of Field Crickets at large, and I fancy that it must occur after dark. In the case of captives the male commences by stridulating with the utmost energy, and so calling the female's attention to himself. Once this is effected he circles round her, drawing closer and closer and chirruping in a jerky *staccato* fashion. His final advances are made backwards.

The female's ovipositor is a flimsy one compared with the corresponding organ in Long-horned Grasshoppers, and it is to be presumed that the eggs are deposited in crannies in the ground, or, perhaps, in the recesses of grass tufts. The larval Crickets are pale in colour. They pass through six or seven moults before hibernating, in somewhat deep holes of just sufficient diameter to admit

1 2 3

THREE STAGES IN THE DEVELOPMENT OF A FIELD CRICKET.

1. Larval stage (September). 2. Nymph stage (March) 3. Imago stage (July). In 2 the body is covered with a fine golden down, and the rudiments of the wings appear. In 3 the wing-covers are fully developed, concealing the wings entirely.

their bodies. It is said that the entrances to these holes are sealed up from within.

Quite early in the spring, the actual date depending on the forward or backward character of the season, the young Crickets of the previous year awaken to activity; but it is not until they are nearly mature that the sexes can be at all easily distinguished. Maturity is marked in the male by the appearance of stridulating wing-covers, and in the female by the complete development of the ovipositor. In the nymph stage, and even earlier, both males and females display a golden sheen due to a fine pubescence on the abdomen; but the mature male is, with the exception of a yellowish band at the base of his wing-covers and a deep-red edging to his hinder thighs, a peculiarly black-looking insect. I am inclined to think that in the case of Crickets, as in the case of Long-horned Grasshoppers, there is a tendency for either male or female to predominate in different broods—it is possible that the broods may be exclusively male or exclusively female; and that the females are less abroad than the males during the daytime.

In July, 1908, Mr. Latter and I caught nothing but males, taking them at the entrances of their burrows, and at that time Mr. Latter had not yet taken a female. In September, 1908, Mr. Latter took a number of larvæ from the same spot by digging, which turned out to be all females. In April, 1909, he took immatures of both male and female in about equal numbers, the holes then having the appearance of having been for some time open. Both in July, 1908, and in April, 1909, an unexpected lodger in the shape of a Carabid Blackbeetle was found not infrequently in the holes, and it was due to the presence of such a beetle that I was enabled to secure my first record of a Field Cricket.

I had been fruitlessly endeavouring to erect my camera in such quiet fashion as to avoid the contingency of the subject making a prolonged stay in the depths of his burrow, and I was not a little surprised to find that this Cricket, who, like the rest, had vanished at the most inopportune time, reappeared backing at top speed, shot out an inch or so beyond the entrance, reversed, and then stopped dead at a point where he could be photographed. For the moment I took no risks, but as soon as I had secured my picture I commenced to tickle him with a grass stem. Instead of bolting down his hole he kicked like a mule, nor could any further provocation drive him downwards. I thereupon took him up, and a glance within

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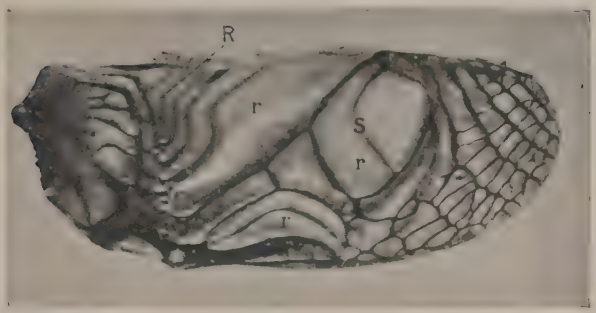
THE HOUSE CRICKET.

1. The female. 2. The male. 3 The female.
The female's ovipositor should be noticed, and the difference in the wing-covers of the two sexes, the male's alone being a stridulating organ. The wings project as two thongs some way beyond the wing covers, the other paired projections being the *cerci*, probably sense-organs, possibly organs of direction.



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THE CRICKET'S INSTRUMENT OF MUSIC.

1. The under surface of the horizontal portion of the wing-cover of a male Field Cricket. R, the round-file nervure; r, r, r, the resonating surface. S, the portion of the resonating surface known as the speculum. In 5 the round-file nervure is seen more highly magnified.
2. The upper surfaces of the horizontal portions of the wing-covers of a male House Cricket, showing the relative positions of the round-file nervures, and of the resonating surfaces when the wing-covers are opened apart.
3. The under surface of the male Field Cricket's left wing-cover, showing both the horizontal and the perpendicular positions.
4. The upper surfaces of the right wing-covers of the male and female Mole Cricket. These are important, as affording the only external means of distinguishing the two sexes. It will be seen that the resonating surfaces in the male (on the left) are more complicated than those in the female.

the hole explained matters. The beetle, whose face I at first mistook for that of another Cricket, was on guard, and effectually barring the entrance. That the Cricket should not have scuttled into the grass was remarkable. It would seem, however, that escape through an avenue of grass stems is not much practised by Field Crickets. At an early stage, such as that of which I give an illustration on page 959 they are extremely lively, and can jump well. As they progress in months, however, their active habits seem to leave them, and once they are headed from their holes they are easily captured. More than one observer has expressed surprise that with their by no means contemptible armament they do not show fight. The Field Cricket is to outward appearance an extremely powerful insect. His round bullet head, his trenchant mandibles, his stout hind legs armed knee to heel with spurs, his steely eye, and his determined attitude, give one an impression not only of brute strength but of science. His looks belie him. The indignity of capture which provokes frantic savagery in the Earwig leaves the Field Cricket limp.

With his own kind he is warlike enough —the males wage battle furiously; and, judging by his dealings with insects smaller

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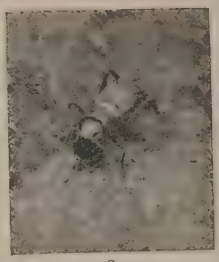

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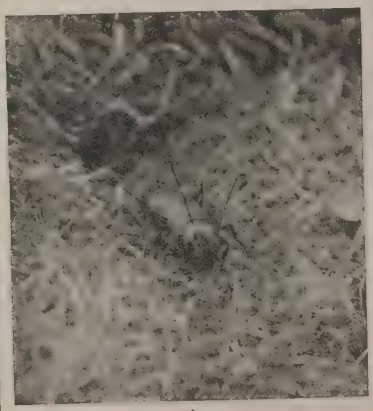

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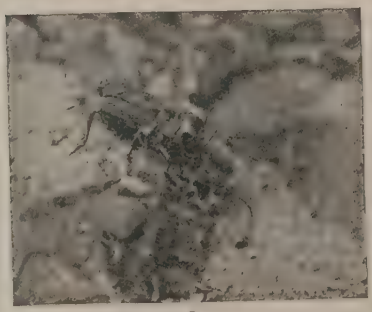

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STUDIES OF THE MALE FIELD CRICKET.

In 1. the vertical portion of the outside stridulating wing-cover can be well seen, and in 2 and 3 its length in relation to the insect's body and its aspect as viewed from above. In 5 the Cricket is "stridulating"; the wing-covers are elevated at an angle of 45°, and the folded flight wings are exposed on either side of the body. In 6 the Cricket is cleaning one of his antennæ by passing it through his mandibles.

than himself in captivity, we are justified in supposing that, in the adult state at least, he is largely carnivorous, and that he sits at the entrance of his burrow waiting for such unwary insect travellers as may alight on it, or cross it.

This supposition is strengthened by the rudimentary development of the Field Cricket's flight wings. The power of flight in insects is in close relation to their natural food supply, and to the means of communication between the two sexes. In the case of Field Crickets, the latter is assured by their gregarious character, coupled with the males' power of stridulation. The folded flight wings of all British Crickets present the appearance of narrow twisted thongs, which, as a rule, project beyond the covering afforded by the wing-covers, and which may project (this is often the case with the Mole Cricket) in a downward curve beyond the hind extremity of the body. Since they are not only folded but rolled, their arrangement at rest is remarkably like that of a rolled-up umbrella. They may be easily spread out with a paint-brush on a moistened slip of glass, and it will then be found that they have a characteristic form which may be described as semi-heart-shaped.

I am doubtful as to whether the expanse of a Field Cricket's wings is sufficient to give him the power of true flight. Gilbert White describes the flight of the House Cricket—who, it should be noted, has much larger wings and a proportionately slighter body—as a wave motion: "*volatu undoso*, in waves or curves, like woodpeckers, opening and shutting their wings at every stroke . . . always rising or sinking"; and says that the flight of the Mole Cricket is accomplished in a similar way. It is possible that a suitable disposition of the wing-covers may assist the progress of both insects, and I may perhaps mention in this connection that the common orange and black Burying Beetle almost inverts his elytra in flight so that their concave portion is uppermost.

The stridulation of Crickets is effected, like that of Long-horned Grasshoppers, by the friction of the wing-covers against one another; but the wing-covers of Crickets are far more highly specialised than those of Grasshoppers. Both right and left are of the same pattern, and apparently interchangeable in position, the left being perhaps most frequently uppermost. A remarkable and characteristic feature of them is that they are divided into two distinct planes, the lower portion of each being parallel to the insect's side, while the upper portion, bent away from it almost at right angles, lies upon the insect's back. It is this upper portion which is employed as an instrument of music. The principal nervures on it may be said to radiate from a point on its inner edge close to the base, which is surmounted by a tuft of bristling hairs. From this hair-tuft, taking the Field Cricket as the type, a stout nervure leads diagonally across the horizontal portion of the wing and, towards the end of its course, borders a transparent oval disc, the main sounding-board, which is about one-eighth of an inch in diameter. From the same point two nervures run directly across the horizontal portion, but before reaching its outer edge turn sharply towards the base. A portion of the hindermost of these is notched like a round file.

As can be seen from the illustration, the nervures at the tip of the wing form a meshwork, but on the remainder of the horizontal portion they branch into bold and often symmetrical loops and curves which enclose considerable areas of membrane.

In stridulating the Field Cricket ducks his head, raises his wing-covers at an angle of about 45°, and shudders them together so that the under surface of the one brushes lightly against the upper surface of the other. This brings the round-file nervure into play against the nervures of the wing-cover beneath it, which in turn convey the vibration to the membranes which they enclose. The sum of the vibrations induced in the membranes of *both* wings is the Cricket's note. It is a sound similar in mechanism and character to that produced by running a stick along a paling, and is, of course, in no sense vocal, though it admits of considerable variation in pitch. The note of the male solitary but hopeful differs decidedly from that of the male in proximity to the female. He can evidently

control both its vehemence and its phrasing, can stop it instantly (it is noticeable that when alarmed he ceases shrilling but keeps the wing-covers raised in readiness for a fresh start), and can recommence either with a sharp attack or with a cautious crescendo.

The male House Cricket's wing-covers are of nearly the same design as those of the Field Cricket, but smaller and of more delicate construction. In the Mole Cricket there is not nearly so much distinction between the wing-covers of the two sexes, but such distinction as exists is of great importance, as it affords the only simple means of distinguishing the male Mole Cricket from the female.

Though several Mole Crickets have passed through my hands, I have neither seen nor heard their stridulation, which was once described to me by a very capable observer as resembling "the tinkle of a tiny silver bell." White makes mention of it as "a low, dull, jarring note, continued for a long time without interruption, and not unlike the chattering of the fern owl, or goat-sucker, but more inward." The descriptions may be best reconciled by assuming that the Mole Cricket varies his tune.

The note of both Field Cricket and House Cricket can be feebly imitated by rubbing the wing-covers of dead specimens together, or by causing them to vibrate with a pin-point, but in the stage reproductions of the "Cricket on the Hearth" the "chirrup" is, I believe, effected by twisting the glass stopper of a bottle, and is decidedly more truthful than most stage noises.

There are innumerable species of small insects in this country whose adaptations to their surroundings can only be realised by studying them alive under the microscope. Among such one occasionally finds modifications of structure which are as extraordinary as they are unexpected; but among our sizable insects—insects, that is, whose form can be seen at a glance—the Mole Cricket occupies a unique position. It is perhaps as well that his distribution is somewhat restricted. Essentially an underground feeder, with a preference for made ground and such vegetable products as are to be found in made ground, he is, in all parts of the Continent where he is abundant, regarded as an unmitigated pest. Like his namesake, the Mole, he drives subterranean galleries, which radiate in all directions from a central cavity in which he lies up during the cold season. This cavity is generally reached by a perpendicular descending shaft. Were his diet mainly carnivorous, his tiny hillocks and the slight disturbances of the surface soil caused by his working might be debited against his services in destroying grubs. There is, however, little doubt that he is vegetarian as well as carnivorous, and that the havoc which he occasionally causes on the Continent in flower gardens, kitchen gardens, and even in cornfields, is due not only to his pulverising any roots which bar his passage, but also to his frequent indulgence in a square vegetarian meal by the way.

1. The "ear" (E) of the House Cricket. The "ears" of the other Crickets and of Long-horned Grasshoppers are situated in the same position on the front legs. It is possible that they are organs of orientation as well as of hearing.
2—4. Three stages in the unfolding of a House Cricket's wing, which, at rest, is partly folded and partly rolled.
5, 6. Larval House Crickets.

He is a remarkably prolific insect, and the only reliable means of lessening his numbers is the destruction of his eggs. This may be accomplished by following a surface run with the finger until one reaches the perpendicular shaft, sometimes as much as a foot in depth, which leads to his breeding quarters. A spade is then driven in suddenly, and, if fortune favours, the "nest" is turned up. The latter is merely an excavation of about the size of a tennis ball, which often contains nothing, but which may contain the female Cricket surrounded by her eggs, sometimes as many as three hundred in number, or by her immature progeny. It is obvious that this method is a slow one, and that it entails considerable labour. Numerous experiments have been made by Continental agriculturists with the object of bringing oil into contact with the Mole Cricket's spiracles. If this can be done, it is a highly effective means of destruction, but the expense and uncertainty attaching to it preclude its employment otherwise than on quite a small scale, and the discovery of some more certain, more easily applied and cheaper remedy would be warmly welcomed on the Continent.

In Great Britain the Mole Cricket, whatever may have been his distribution in Gilbert White's time, must now be reckoned a scarce insect. He is common in the Channel Islands, but with this exception he is practically confined to that small group of southern counties which appear to derive their fauna from their proximity to the New Forest. All observers, from Gilbert White onwards, are agreed as to his normal liking for moist surroundings, and I have found captive specimens thrive best in a moist heat, care of course being taken not to cause them discomfort by any unnecessary exposure to sunshine.

A few lines must be devoted to the House Cricket—the "Cricket on the Hearth." How much of his fame is due to his comparative abundance, and how much to the genius of Charles Dickens, it is impossible to determine. From the frequency of reference to him in literature of the past, and the infrequency of first-hand experience of him in literature of the present, I am inclined to think that he is less common than he used to be. It has been suggested that the Cockroach has supplanted him in the kitchen, though he still holds his own in the bakehouse. He must be regarded as a parasitic insect; it is very unusual to find one out of doors, and, when he *is* out of doors, he is usually in the manure heap. His original starting point is as much of a mystery as is that of the rats or mice. His song is pleasing to some ears, but I must confess that it soon becomes monotonous to my own. Unlike the Field Cricket, he is an excellent jumper and runner, and requires some catching, the simplest method being to invert a tumbler over him. I have found him a most difficult insect to keep in captivity, even when due precautions have been taken to keep him in a high temperature. The degree of heat which he enjoys, the ease with which he can scuttle over smouldering embers, and the frequency with which he will wedge himself between hot-water pipes, are alike astonishing. Unlike most insects whose habitations are dark, he is a light ash-brown when mature, and whitish in the early larval stages.

THE FOREQUARTERS OF A SPECIMEN MOLE CRICKET.

The extraordinary modification of the fore limb into a digging tool should be noticed. C, the coxa. F, the femur, or thigh, with a blade projection from the base, which engages (see left-hand limb) with the hindmost projection of the wonderful tiba, or shin, T, forming a pair of shears. Only the extremities of the tarsal joints, T', which form another pair of shears with the tibia, T, are visible. It has been estimated that the Mole Cricket employs a force equal to 2 or 3 lbs.

Of our fourth species, the Wood Cricket, I have no first-hand knowledge. Though abundant on the Continent, he appears in this country to be confined to the New Forest. DOUGLAS ENGLISH.

DEWBERRY (IN FRUIT).

FAMILIAR WILD FRUITS

By BENJAMIN HANLEY

With Photographs by the Author

As the harvest-tide of the year approaches and flowers give way to seed and berry, when Nature puts on her autumnal dress of gold and bronze, many kinds of wild fruits may be found up and down the countryside. Of these the hedgerow has a goodly share, and although to the great majority the one and only fruit of the hedge is the Bramble, there are, nevertheless, others even more interesting.

The first likely to be noticed is that of the Hawthorn (*Cratægus oxyacantha*), great bunches of fruit, known as "haws," lining the branches and giving the bush quite a ruddy tinge. These have resulted from the clustered creamy foam of the "May" blossom. During the winter months these haws form the staple diet of many birds of the thrush family; our winter visitor, the fieldfare, would be badly off indeed but for these. The missel thrush sets apart a bush for his own special use, and jealously guards it, fiercely attacking any feathered robbers, and almost all day long in early winter one may hear him harshly protesting against their thievish ways. The haw has a thin, fleshy coating, and beneath this is a hard woody case containing the seed. The Hawthorn is a very valuable material for hedge-making; that this was known to our ancestors is proved by the fact that its name is derived from a Saxon word meaning "hedge thorn."

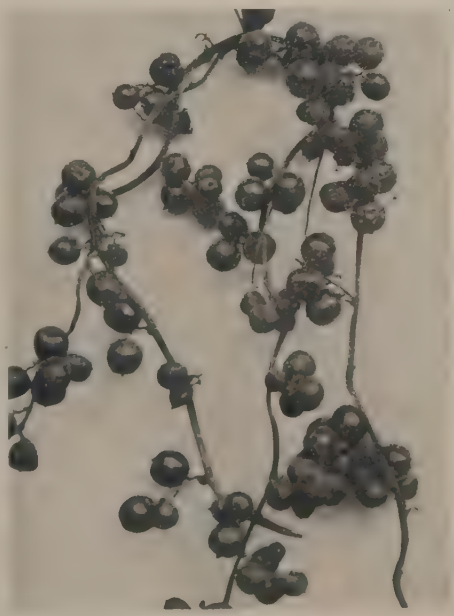
Towards the foot of the hedge one may find berries almost like those of the Bramble, covered with a rich purple bloom. This is the fruit of the Dewberry (*Rubus cæsius*), a near relative of the Common Bramble (*Rubus fruticosus*). It may be recognised by its more slender branches, which possess only very small prickles. Again, it does not flower so profusely as the

HAWTHORN (IN FRUIT).

Bramble, and the blooms are larger and pure white, whilst the fruit is made up of fewer, larger grains. The purple bloom gives it a very tempting appearance, and it does not belie its looks, for if tasted it will be found far richer in flavour than the more common fruit. The blackbird is especially fond of this fruit. The novice may always tell whether a fruit is the Bramble or Dewberry by looking at the five segments of the calyx at the base of the fruit. If these are thrown back round the stem it is a Bramble, but if they rise round the fruit, a Dewberry.

The Crab Apple (*Pyrus malus*) may frequently be met with as a tree of considerable size, but more often it is seen merely as a shrub or small tree growing in the hedgerow. The blossom in spring, in the opinion of many, is the most lovely of all our wild flowers, and the rosy-cheeked fruit is certainly very beautiful in appearance, but, being rich with malic acid, they are by no means pleasing to the palate; all the same, however, a delightful jelly can be made from them, and in former days a kind of cider was also manufactured from this fruit.

A very common fruit of almost every hedgerow is that of the Black Bryony (*Tamus communis*). This is the plant whose trailing leaf-wreaths rival all other climbing plants during the summer. Then the leaves are very bright and dark green, sometimes purple-black, but in autumn these change like other foliage and become yellow or brown. The berries, borne in clusters, pass from green through yellow and orange until they assume a brilliant scarlet hue. As the fruit may be seen in all these stages in early autumn, the plant looks very attractive from a distance. At the same time, the fruit never strikes one as being tempting, and, if tasted, one would be sufficient, as it is raw and acrid in flavour. The berries remain on the twining stems long after the leaves have fallen,



BLACK BRYONY (IN FRUIT).

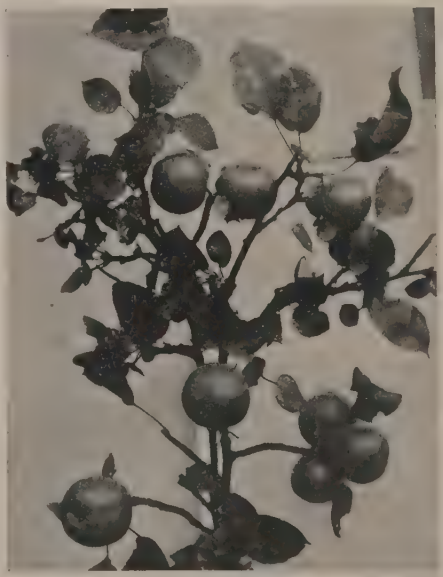
WOODY NIGHTSHADE, OR BITTER-SWEET (IN FRUIT).

flowers, borne in small clusters, are deep purple, with bright yellow anthers. It is interesting to note that the clusters of flowers invariably all face one way and the leaves another. The fruit, ovate in shape, is at first a bright green, but as it travels towards maturity it changes gradually until it becomes a rich crimson like the berries of the Bryony. Each fruit contains a number of seeds. This plant is often mistaken for its more dangerous relative, the Deadly Nightshade, or Dwale (*Atropa belladonna*), which bears solitary pale purple, bell-shaped flowers and dark purple berries almost as large as a cherry. Fortunately, this last is the rarer of the two, but it should also be added that the juice of the stem of the Woody Nightshade is poisonous.

The Alder Buckthorn (*Rhamnus frangula*) is a fairly common shrub, and, indeed, is more often met with and give quite a touch of colour to the otherwise bare hedge.

The Black Bryony is especially interesting as being the sole British member of the Yam family. This plant should not be confused with the White Bryony (*Bryonia Dioica*), for although both are climbing plants, and both produce red berries, they belong to totally different families. The leaves of the White Bryony are large, five-lobed, and rough in texture, and from the stem at the base of each is a long spiral tendril. The leaves of the Black Bryony, as I have already noted, are very bright, heart-shaped, with smooth edges; and this plant has no tendrils, but climbs by means of its stem.

Another wild fruit almost sure to be noticed is the Woody Nightshade, or Bitter-Sweet (*Solanum dulcamara*). The latter name is given from the fact that if a piece of the stem be tasted it will at first be found bitter, but afterwards sweet. This plant grows in the hedgerow, forcing its stems amongst other sturdier plants, so gaining support from them. The



CRAB APPLE (IN FRUIT).

than its near relative the Common Buckthorn (*Rhamnus catharticus*). The former has rounded leaves with smooth edges; the berries, about the size of a pea, are borne singly, and are of a purple hue; further, the stems bear no thorns; but in the case of the latter the leaves are toothed, the berries are black and often clustered, whilst the twigs often end in a thorn.

From the crushed berries of the Common Buckthorn is prepared the syrup of Buckthorn—a medicine now but little used. A yellow dye is also made from the unripe berries. But it is for the entomologist that this shrub has special interest and attraction, on account of its being the food plant of the caterpillar of that beautiful sulphur-coloured butterfly, the Brimstone, an insect which delights the eyes of all who see it.

BENJAMIN HANLEY.

ALDER BUCKTHORN (IN FRUIT).

THE ROSE GARDEN

"A Garden of Roses is complete and fully satisfying"

By H. H. THOMAS

IT matters not how many kinds of flowers a garden may boast if Roses are absent; nor how few if Roses are among them. The former lacks the essential spirit of garden life, while the latter has little to gain by the inclusion of other blooms. Roses form, as it were, the corner-stone of the garden. If the foundation is laid with the queen of flowers, then the garden may extend its bounds away and beyond, stranger petals may flutter here and flutter there, for the heart of it all rests firm and sure amid the rich colour and sweet fragrance of the Roses. As a rule, every man begins to make a garden by planting Roses; he feels that with Roses wanting his garden would be as a country without its queen, elf-land without its fairies. There are few flowers with which alone a garden can be made, and among those few the Rose stands easily first. A garden of Roses is complete and fully satisfying. No flower is such a host in itself; not only does it possess the attributes of a perfect blossom, rich colour and fragrance, but for variety of form in leaf and flower it is unapproached. One may have Roses that grow only a foot or so high, others that throw their slender growths to a height of fifteen feet or more among the leafage of holly or the lichen-crested boughs of some aged orchard tree, and between the two extremes there is variety indescribable—and all of Roses.

A Rose garden of to-day is very different from that of ten years ago, owing chiefly to the remarkable progress made by workers among the flowers, whose lot it is to enrich our borders with Rose treasures that fall, as it were, from the lap of the gods. Progress has been most marked

among the climbing and creeping kinds. A generation ago Gloire de Dijon was looked upon as the typical Climbing Rose, and not only was no Rose garden complete without it, but there was none to usurp its place. One might say with much truth even now that Gloire de Dijon is well worthy of inclusion, for it is one of the earliest to open and one of the last to close. But it is a puny thing beside the luxuriant climbers which chiefly American rosarians have evolved from the dainty, pink and white flowered, almost evergreen Creeping Rose from Japan, and some of the large flowered kinds. They have made of our Rose gardens a rich feast of glowing colour, luxuriant bowers of glorious blossoms that hide the very shoots and leaves that gave them birth. The blooms come not in twos and threes, but in lax bunches, each of which is in itself a real bouquet. Their slender twining stems quickly cover the arch or arbour, pole or pillar that supports them, and their lustrous leafage alone is beautiful to look upon; beautiful in early summer before the buds have burst to blossom; beautiful still when the flowers have faded, for these newer Roses are almost evergreen. And best of all, perhaps they grow as only they know how to grow, and scorn the coaxing which the old Gloire de Dijon has so come to expect that now it cannot do without. And how they blossom! As though the very world were one of bloom and they must lead the way.

Not only should the perfect Rose garden be full of Roses, but Roses must encompass it. Without—smothering all boundaries, festooning gateways, climbing into and hiding the base of neighbouring trees. Within—sheeting arbour and arch, bed and border and trellis with a wealth of fragrant bloom. A Rose garden must be a garden of Roses—of Roses and little else. We may, with propriety, allow the blue spires of Larkspur to rise here, and group the bounteous Pæony there, and among them all, hiding the bare soil beneath a lovely carpet of bloom, plant Pansies and White Arabis, Candytuft and Mignonette. But chiefly the Rose garden is to be a garden of Roses—Roses that clamber and climb and creep, Standard Roses, Dwarf Roses, Sweetbriar and China (and round about these a casual bush of Lavender and Rosemary), and all the other Roses, new and old, that are available to grace the garden of to-day. Roses, too, clambering over the porch and peeping in at the bedroom windows, Roses for edgings and Roses for hedges. Indispensable for planting without is the Musk Rose from far Himalaya, whose olive-grey leaves have almost as subtle a charm as the large, white fragrant flowers which the slender growths flaunt gracefully at a height of fifteen feet or so. There are few Roses to approach this for sheer vigour of growth, for luxuriance of leaf and blossom. Plant it fairly and well in soil made rich and firm, and in the course of a few fast-fleeting years, lo! you have a giant in the Rose garden, that has thrown a screen of fragrant beauty across the face of the workaday world—the world outside the Roses—shutting out the world, shutting in the Roses. Yet how few grow this Rose. You may see it in the Dell at Kew, and in the gardens of peers and princes, but in countless others where it would thrive equally well it is not known. Yet the Musk Rose is democratic and not fastidious; it will thrive in the public plot of the wayside cottage as finely as in the exclusive solitude of the lord's domain. For, like almost every other Rose, it is not magnificence it needs, but tender, kindly care. And what I have written of the Musk Rose is equally true of others—of others that clamber and climb. Start them well, plant them carefully in land enriched and well prepared, and there is no doubt of the result—a graceful thicket of growths that in due season glows beneath a canopy of leaves, bright, shining green, and finally sparkles like precious stones when the sunlight plays about its load of blossom. And for the names of some of the Roses that light up the garden in summer, and above all in early summer, with a radiance borrowed from fairyland?

Here are a few of the best, and none, I think, were known or grown ten years ago. Dorothy Perkins and Lady Gay (pink); Blush Rambler; Philadelphia Rambler (red); Wedding Bells (pink); Hiawatha (crimson and white); Tea Rambler (copper and pink shades); White

Dorothy Perkins; Papillon (pink and white). But the perfect Rose garden is not made with new Roses alone; some of the older sorts still hold their own. Such, for instance, as Reine Olga, which flaunts her giant crimson-scarlet petals in queenly fashion above large, bright green leaves; Aimée Vibert, almost the oldest and perhaps the best of the white-flowered Climbing Roses; William Allen Richardson, still unsurpassed for intense orange or apricot colouring; Reine Marie Henriette, commonly called the red Gloire de Dijon, and Crimson Rambler, still unapproached for rich and brilliant colour. One more to name and I have done with the Rambling Roses, the garden's fairest flowers, the embodiment of grace and live, luxuriant beauty. This one is something of an anomaly; it was raised in Switzerland, has a German name, Conrad F. Meyer, and is really of Japanese origin, for the thorny Japanese Briar is one of its parents. It grows vigorously, ten feet or more high, its shoots are armed with strong, stout spines, and it bears quite early in summer a burden of exquisitely formed and fragrant rose-pink blooms that would captivate the heart of the least impressionable, and win the whole-souled admiration of the most indifferent gardener. It is a Rose, that more perhaps than any other of recent introduction, has intensified the glamour that hovers about the court of the queen of flowers—in short, if I were Pagan, a Rose that I would worship.

Within the Rose garden Standard and Bush or Dwarf Roses are of chief importance. The Standard Rose has fallen on evil days in the twentieth century, and the reason is not far to seek. It failed to march with the times. With a few notable exceptions (one of which is shown in the accompanying illustration) Roses when grown as Standards became stunted, bare of leaf and sparse of blossom. The demand of the Rose lover of to-day is for free-growing sorts that smother their shoots in flowers, Roses that give prodigally in return for little expenditure. Consequently the Rose grower looks askance at the old-fashioned Standard. But its star is again shining; it has taken a new lease of life and, in a different form, is regaining the affection it went near to

A GARDEN OF PINK ROSES.

STANDARD ROSES IN JULY.

losing altogether. In its season a Standard Rose may be the most exquisite flower picture in the garden, or it may be, as often it is, one of the least attractive. But the Weeping Standard and the free-growing, in contradistinction to the "mop-headed" plants, are fast becoming popular, and soon they will compel greater admiration than the old Standard Rose did in its palmiest days. The true Weeping Rose, if not altogether a creation of the latter-day florist, owes its increasing popularity to his endeavours. Imagine a stem five or six feet high from the top of which depend gracefully and symmetrically long, slender growths that reach to the ground, crowned with lustrous leaves, studded with brilliant bloom, forming a perfect parasol of blossom. Fix in your mind's eye this exquisite portrayal of Rose beauty, and you have an impression of the rare and singular charm of the Weeping Standard Rose. It is unique; the garden contains nothing quite like it, and it has been made more characteristic still by the introduction of the new American-Japanese climbing varieties. They depend from the top of a Briar six feet high with as fine a grace, as subtle a charm, as they climb about the larch or oak pillars of a pergola. Ten years or so ago few thought of using the Climbing Rose as a standard; to-day it stands as the type that will save the standard from neglect and possibly oblivion. Such free-growing sorts as Crimson Rambler, W. A. Richardson, Gloire de Dijon, and other favourite climbers, make delightful standards. They do not form Weeping Standards like Dorothy Perkins, Hiawatha, and other extra vigorous Roses, but they are far more beautiful than the prim and proper specimens that were appraised so highly not very long ago, despite the fact that Dean Hole was never tired of condemning them. "Their appearance is unhappy," he wrote, "there is no congruity between stock and scion, no union between horse and rider—an exposition, on the contrary, of mutual discomfort as though the monkey were to mount the giraffe."

The Roses that fill the greater part of our gardens, with which we plant beds and borders, and upon which we rely for blooms of perfect form and exquisite colour

shades, and for fragrant petals, are Bush or Dwarf Roses, now to be obtained in hundreds if not in thousands of varieties. Dozens of new ones are sent out every year by professional growers, and last year alone nine survived the severest test of all, and received the gold medal of the National Rose Society. The profusion with which new Roses are now showered upon flower lovers is remarkable. Some have only a fleeting career; they flash in the firmament of Roses as meteors across the sky and are gone, to be seen or heard of no more; they were not so good as Roses already in cultivation. Others, more perhaps on account of their novelty than in virtue of any real merits they possess, shine brightly for a few seasons, but alas! they fail to live up to their reputation, and their light, too, goes out. Public opinion moulds the destiny of a new Rose. Let it be whispered that the colour is not pleasing, that its petals are ill-formed, that it lacks any one of those qualities which stand for birth and breeding, and not the greatest effort can avail to set up a new Rose on the pinnacle from which it has fallen. In many ways the newer sorts are a great improvement on the old ones; chiefly because they give us flowers in summer and autumn, while formerly we were well content to gather Rose buds in June and blossoms in July. Nowadays a carefully planted garden is gay from May until October. Most exquisite of the new Roses are those of yellow, apricot and old gold shades, such, for example, as Madame Ravary, Betty, Mme. Pierre Cochet, Harry Kirk and Souvenir de Pierre Notting. Those are among the most delightful Roses in cultivation, and some of them should be in every border. Our chief lament now is for crimson Roses that will bloom in autumn as well as in summer. In September our Rose buds are gay with blooms in white, pink, rose-pink, salmon-pink, and many other shades of pink, but the crimson Rose is conspicuous chiefly by its absence.

After all, the most treasured possession of our Rose garden, the characteristic that is of paramount value, is the quality of fragrance. We might dispense with perfectly formed petals in entrancing colour shades, with continuity of flowering and vigour of growth; all these are as nothing if in gaining them we lose fragrance, for this is the very soul of a garden of Roses. The glamour which invests its leaves and flowers is born of fragrance; in fragrance it must live, without sweet scent must die. Yet many of the new sorts which have come to stay are not sweet scented, and they deserve no place within the flower-embosomed gates of the garden of Roses. H. H. THOMAS.

SOME TYPES OF BIRDS' NESTS—II

By BENJAMIN HANLEY

With Photographs by the Author

PROBABLY a nesting ramble in a country lane yields the best results, for in such places there is usually to be found more variety than elsewhere. One can tell from the variety of bird voices heard that many kinds of nests are to be seen for the seeking.

The Song Thrush fluently singing from the topmost branch of an oak tree is happy in the knowledge that somewhere deep down in the hedge beneath him his mate is safely covering her black-spotted turquoise-blue eggs in their cup-shaped resting-place; the Greenfinch swaying gently at the end of a twig monotonously "cheeing" to his sitting mate; the Black-

NEST OF BLACK-HEADED GULL.
Supposed abnormal clutch.

bird which flies silently from a bush and then cackles noisily after gaining a safe distance; the "chacking" of a Whitethroat as you approach that thicket; the scolding of the Sedge Warbler as you pass the tangled vegetation by the dyke side—all these, and more, tell of hidden homes and treasures dear to the hearts of each possessor. In such a place there are nests by the score—many Thrushes with young, some with full clutches, others yet in the "wet" or "ready" stages—to fall into the vocabulary of our school-days. Some of the Song Thrushes have already left their nest, and as you walk along the commotion of the old birds gives you the first clue to their whereabouts; then you hear a chirp from somewhere near, but although you look long and carefully no bird can be seen. When almost tired of looking the eye suddenly catches sight of it, and you think how conspicuous it is, and how absurd that it was not seen at once. But in all probability it is not in such a conspicuous position as one might hastily conclude. Leave it for a moment or two, then retrace your steps, and although the bird has not shifted its position in the least, one has the same difficulty in locating it as before—so much for protective resemblance, which, in this case, is well illustrated.

Of Blackbirds' nests there is no lack, and although the homely Hedge Sparrows are quite as plentiful, one does not find so many, for the majority are cunningly hidden behind some ivy-clad stump; but when even one is seen, with its dainty eggs of heaven's blue, one thinks that this surely is the prettiest egg of all. Somehow everyone seems to have a warm corner in his heart for our humble friend "Shuffle-wing," or "Cuddy" as the school lads call him. Soon from a bank side a Robin is seen to fly out, and on going to the spot the nest with its red-speckled eggs is soon discovered.

Perhaps we may stumble upon a young prodigal who, not content with his

NEST OF SONG THRUSH.

NEST OF ROBIN CONTAINING SIX WAGTAILS' AND FOUR ROBINS' EGGS.

A pair of each bird visited the nest, which was built by Robins.

surroundings, takes to exploration with disastrous results to himself. Here we may bring joy to his parents' hearts by restoring him to his family.

If we are fortunate another youngster—not a prodigal this time, but one might perhaps be justified in saying a glutton—a young Cuckoo filling, and often overfilling, its foster-parents' nest, sitting with gaping mouth all day long, thanklessly taking the dainty tit bits its devoted attendants so frequently bring; and yet its appetite remains insatiable. How many times a day must they feed that greedy mouth! They have apparently very little time to look to their own requirements.

Yonder is a cock Linnet resplendent in crimson breast and forehead. The nest, not built in a furze bush as is so often the case, but in a hawthorn hedge, is not difficult to find, and as the branches are slightly pulled to one side the eggs are seen: white faintly tinged with blue, spotted with reddish brown and purple. Only a few yards farther the same hedge yields another treasure, only much lower down this time, amongst the tangled vegetation—a Garden Warbler's home—with four muddy white eggs stained and spotted with light and dark greenish brown.

Farther on a hen Corn Bunting flies from her lowly nest on the ground and joins her mate sitting on the top of a gate, plaintively singing, leaving her eggs plain for us to view.

* * * * * *

During a nesting ramble one often happens upon nests built in curious or even unique situations, or possessing something unusual, and rendered especially interesting on that account. Such a one is the mixed nest of a Robin and Pied Wagtail here shown. It was found in the side of a haystack, and it would appear that the Robins were responsible for its formation, as the nest of the Wagtail is not usually so neat as this specimen. When discovered it contained two Robins' and two Wagtails' eggs, and a week later four Robins' and six Wagtails' eggs.

The eggs of the Robin may be distinguished in the photograph by their mottled appearance and more rounded shape. At first both pairs of birds visited the nest, the Wagtails coming on the scene as soon as it was built, and being the stronger birds eventually drove the Robins farther afield. Incubation was undertaken by the Wagtail, and it would have been very interesting to see how the "dish-washers"

NEST OF CORN BUNTING.

would have managed such a mixed family, but the inevitable small boy came along and appropriated both nest and eggs.

Contrary to what one might think, Moorhens frequently nest in trees or bushes. I have found them at various heights from three to twelve feet from the ground. The one found at a height of twelve feet was placed on the top of a Wood Pigeon's old nest. In such instances the young apparently must be carried down to the water by the parent birds.

The usual number of eggs in a Black-headed Gull's clutch is three, sometimes only two, but a few seasons ago I found two nests containing four each and one with five. These I thought were really remarkable, but later on I found the explanation rather disappointing, although at the same time delightfully simple. Some youths had been surprised whilst "collecting" at the gullery by the keeper, and, in their anxiety to get rid of the eggs in their possession, had hurriedly dropped more than the usual number into three nests. Needless to say, it does not do to take too much for granted. I may add that in each of these supposed abnormal clutches the eggs were safely hatched.

* * *

Still we might continue our way and see many more nests, some needing careful search so cunningly are they hidden, and others quite conspicuous, until we at length reach the highway once more with its noisy traffic and white, choking dust; but still we carry away pleasant recollections of what we have seen and heard in a leafy lane.

BENJAMIN HANLEY.

NEST OF GARDEN WARBLER.

CORNFIELD.

From the Water-Colour Drawing by C. E. Flower.

Photograph by P. Webster, Newcastle-on-Tyne.

PINNACLE ROCKS, FARNE ISLANDS.

HOW TO KNOW THE BIRDS

By the REV. MAURICE C. H. BIRD, M.A., M.B.O.U.

THE SWIMMERS—III

WHEREVER there are large ponds, lakes, or slowly flowing rivers, there the Little Grebe, or Dabchick, may be looked for. It is a very shy and silent bird, seldom rising from the water, but equally at home beneath the surface, rapidly disappearing from sight on the slightest alarm, and that without making a ripple on the water. Some twenty years ago, whilst shore-shooting on Canvey Island, Essex, I surprised a family party of five of these expert little divers—they are only about nine inches in length—on a small bare-edged pond, saw them all submerge themselves, watched that pond for nearly half an hour, but not one of them meanwhile revealed more than a beak tip!

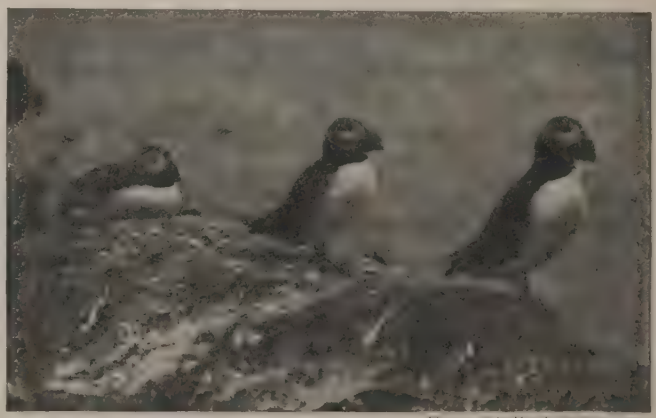
The far larger Great Crested Grebe, and a much more imposing bird, especially in the breeding plumage, with horn-like ear tufts, and brown and chestnut ruffle, seems to be increasing its range, or at any rate increasing in numbers during the nesting season, since the passing of the Bird Protection Acts. It is rather more shy and wary than the Dabchick, but is not so silent, and therefore when once its harsh and loud call-note, "kurruk, kurruk," is known, attention is

Photograph by P. Webster, Newcastle-on-Tyne.
GUILLEMOTS.

called to the presence of a bird whose proximity would otherwise remain undetected. The "Loon" seldom seeks safety in flight, and when detected on the open water at some distance from the shore will often continue to swim rapidly away, incessantly turning its head from one side to another, so as to keep an eye upon its pursuer; but if your boat gains rapidly upon it, or the bird has approached within some ten or twenty yards of the reed-clad shore or sedge-encircled bank, it will dive at once—it never actually swims into hiding.

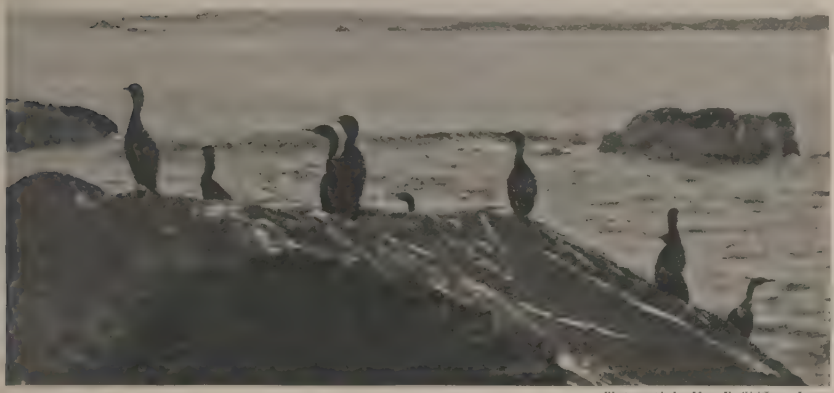
Both species build floating nests of semi-decayed vegetation, the mass being anchored to water plants, and constantly added to as incubation proceeds. The four to six eggs, dull white when first laid, are half buried in the surface of the almost flat nest, which is in fact a miniature hot-bed. The parent bird always covers her treasures when leaving them, and the rapidity with which this can be done is truly marvellous. The nestlings are lovely little objects, with brown and white zebra-like markings and a pink patch on their foreheads. The stripes on body, neck and head soon disappear, but the succeeding down is retained until the young birds are more than three parts grown. On the wing the adults have a straight flight, generally only a few feet above the surface of the water, with outstretched neck and legs, and rapidly vibrating wings in which the white secondaries are conspicuous. There has recently been some correspondence in the natural history papers on the late nesting habits of this species; it is a mere question of local vegetation. On our Norfolk Broads the Great Crested Grebe is very early in commencing to breed. As the reeds are as a general rule only cut once in two years in the same place, the "Loons" can always find sufficient concealment somewhere as soon as nature suggests nesting.

The rock birds—Guillemot, Razorbill,



Photograph by Mrs. L. Smythe, Lewes.
PUFFINS.

and Puffin—close-feathered, lumpy birds, feeding on fish, and carrying much fat, are each of them black above with white under-parts. The wings are short and pointed, reaching almost to the tip of the inconspicuous tail; the feet are webbed and set far back. All are gregarious at all seasons, and spend most of the time at sea. The first two are residents, but the Puffin winters further south. Guillemot and Razorbill are about eighteen and seventeen inches long respectively. The chief distinguishing mark between the two is the beak, which is black in both species, but that of the Guillemot is comparatively straight, pointed, and whole-coloured, whilst that of the Razorbill is arched, much compressed, and hooked at the tip, and has one, two, or three white transverse bars, according to age, on the upper mandible. There is also a white line extending from the base of the beak to the eye. The smaller Puffin, or Sea Parrot, has a white or smoky-white face and a very peculiarly coloured and distinctively shaped beak, shorter than the head, and very much arched, wider, or rather higher, than it is long, slaty grey in colour with orange-coloured ridges, and almost red tip. A patch of loose yellow skin at the gape allows the mandibles to be opened widely. The orbits and feet and legs are orange-red. A further peculiarity about this grotesque bird is that the basal covering of the beak is shed in the autumn. In common with the Guillemot and Razorbill it lays but one egg, which is of a dirty-white ground colour, very faintly marked with lilac; this is either deposited in a rabbit burrow or in a hole tunnelled out by the bird itself. The Razorbill lays its very handsome solitary egg—which is pyriform and whitish or pale brown in ground colour, blotched and spotted with various shades of deep rich brown, chiefly at the larger end—in close proximity to those belonging to other members of the colony, on the bare rock ledge, its shape being its only safeguard from being rolled into the sea or dashed on the rocks below, when the parent bird is frightened from it. But this provision of Nature reaches its greatest development in the blue-shelled, black-scrawled egg of the Guillemot, which is even more decidedly pear-shaped.



Photograph by Miss E. Shiffner, Lewes.

SHAGS.

The chief difference between the Cormorant and Shag is in their size, the former being three feet in length, and the latter about eight inches less. Both

are almost entirely black, but the former is purplish black, and in the breeding season has a white chin, delicate white hairy feathers on the neck, and a large white thigh patch; whilst the Shag has rich dark green reflections, and a crest which curls forward at the back of the head, and no white about the body. A less obtrusive difference, but one constant at all seasons, is that of the Cormorant having fourteen tail feathers, and the more local Shag only twelve. Both birds build in colonies.

Photograph by P. Webster, Newcastle-on-Tyne.

RAZORBILLS.

The adult Gannet, or Solan Goose, is a purely maritime bird; large, as its secondary title suggests, its wings extend to six feet, though its length is only thirty-four inches. In full plumage the general body colour is white, with black feet and wing feathers. The head and neck are tinged with buff, and the bare skin at the base of the beak is dull blue. The first plumage, or rather the plumage of the first year, is almost black, with white spots—after the white nestling down is lost—the under-parts pale brown. It is not until the sixth season that the adult plumage is assumed. Never quitting the sea, except when storm driven, this bird is not likely to come under the observation of land-dwelling naturalists, but those whose business or pleasure takes them near its breeding haunts or fishing grounds will experience much pleasure in watching the tremendous plunges—generally successful—which this grand bird makes upon surface-swimming fish.

Of the Terns, or Sea Swallows, two species are fairly common summer migrants, the Common and the Lesser Tern; the Arctic also breeds sparingly in a few localities. All have been benefited by the Protection Acts. They are Gulls in miniature, with elongated wings and beaks and forked tails, the most graceful in form and flight of all sea birds, with black crowns, pearl-grey upper parts, and white below. Common and Arctic are inseparable as to size, the beak being the most distinctive feature. In the Common it is deep orange-red with a black tip, whilst that of the Arctic is blood-red throughout. In adults the tail feathers are longer and the *tarsi* shorter than in the Common species. The Lesser Tern has a yellow beak and orange-coloured legs. All three build in colonies, making but little nest on the sand or shingle and laying two or three eggs each.

Of the six commoner species of Gulls, the Great Black-backed is the most solitary and also the largest, measuring about thirty inches and having a wing spread of 5 ft. 9 in. The feet and legs of this bird are pale flesh colour, which fact alone will serve to separate it from the more frequent Lesser Black-backed, which has them yellow. It measures about twenty-two inches. Their black mantles mark them off from the other four species. The Herring Gull is only a trifle larger than the foregoing, but its lavender back distinguishes it from the adult Great Black-

Photograph by Miss E. Shiffner, Lewes.

BLACK-BACKED GULLS ON GANNET ISLAND.

Photograph by P. Webster, Newcastle-on-Tyne.

KITTIWAKES.

backed, and its flesh-coloured feet and legs mark it off from the Lesser Saddle-backed. In full plumage the whole head, tail and body colour of these three Gulls is white, as is also that of the Common Gull and Kittiwake, which, eighteen and sixteen inches long respectively, have both grey mantles, but the so-called Common Gull has greenish-yellow feet and legs, whilst those of the Kittiwake are dark brown ; from the absence or very rudimentary condition of the hind toe, this bird is scientifically known as the Three-toed Gull. The Black-headed, with deep coral-red feet and legs, is perhaps the most widely distributed of the species, and therefore more deserves the title of "Common" Gull ; moreover, its chocolate-coloured head in summer is only represented by a dark ear-patch in winter, at which season it straggles far from the coastline seeking worms and slugs and grubs from flooded pastures and freshly ploughed fields. On the wing it shows more white than any of the previous five. In all species the young are more or less marked with brown, and the tail feathers with black. Immature birds of the three first-named species are commonly mixed together as "Grey Gulls." In flight the adult Common Gull shows white tips to the primary flight feathers, whilst those of the Kittiwake are black throughout. A conspicuous white edge to the wing distinguishes the Black-headed, and in the hand the mouth and gape of the Common Gull will be seen to be lead-coloured, whilst that of the Kittiwake is vivid orange. MAURICE C. H. BIRD.

THE LIFE EPHEMERAL

THE MAY FLY AND ITS LITTLE DAY

By R. A. STAIG

OF summer and the flowing stream are the May Flies. Fragile creatures —how softly they settle, folding close their gauzy wings like a scintillating sail ; their slender bodies curving elegantly upward ; the long, delicate tail filaments waving to and fro.

They cast their eggs upon the waters, but the eggs are not swept away, for each one has minute knobbed threads which serve as anchors in the mud. Six or seven months may pass ere the larvules hatch out. Very slowly these tiny things grow, gradually becoming large-eyed nymphs with sheathed wings showing behind the head, and with two or three filiform tails, features suggestive of the future flying form. And the rows of little leaf-plates fringing their sides : these are not oars for swimming, but appliances for breathing, provided with air tubes, or tracheæ, by means of which the oxygen requisite for bodily aeration is extracted from the water.

Rounded in form and stout of limb are the nymphs that burrow in the oozy banks. The flat species are usually found in swift streams upon the under surfaces of submerged stones. They run rapidly and with a wriggling motion. Some kinds, which have the tails thickly set with cilia, swim freely. There are others that wander about covered with mud and are thus concealed.

Two years, more or less, these larval May Flies haunt the dark recesses of the streams, then suddenly comes the hour of their summer emergence to aerial life. They float on the surface, the skin of the back bursts open, and within ten seconds out comes the winged Ephemera and flies away.

When the skylark soars in the zenith of the heavens, carolling June-day vespers,

Photograph by Wm. Kinghorn, Glasgow.

ON THE LEFT IS THE "DRAKE" OR SUB-IMAGO OF *EPHEMERA VULGATA*, AND BELOW IT IS SHOWN ITS EXUVIA, THE MAY FLY "GHOST." ON THE RIGHT IS THE IMAGO OR PERFECT FORM OF *EPHEMERA VULGATA*.

down in the shady deeps of the troutpool the "speckly one" rouses himself from his late siesta—the lazy stretch, graceful withal; the back-watering, then the yawn prodigious, and off he fins to the eddying shallows—hungry, expectant.

While he drowsed in the pool myriads of May Flies left the water to change their birth robes hurriedly 'mid leaf and blossom. These are the "duns" and "drakes" of your enthusiastic angler. Thither they went to throw off the green for a lacery yet more dazzling, more resplendent. By the banks, upon grass stem and tree trunk, they hang their filmy cloaks. We call these May Fly "ghosts." Preparation for a brief hour of pleasure, for the giddy dance of love and death. Over the woodland stream gathers a living cloud, swirling deliriously, sparkling in all the transient glories of gossamer wing and flowing silken tail-plumes. Witness the hurried courtship; the embrace of a moment; the separation to die. The sudden agitation of the water seems to prophesy the tragedy; splash after splash, circle following circle—'tis the hungry rise of the "speckly one"; a rich feast, a tragic farewell!

The whirl subsides; the cloud thins and scatters as they hover out of life—the May Flies of an hour ago, those that escaped the sure suck of the lurking trout; those that were successful in their last act in life.

The tranquil stream is the cradle of the children they never live to see! Such is the life ephemeral, the maturity that lasteth but an evening!

R. A. STAIG.

Photograph by Wm. Kinghorn, Glasgow.

ON THE LEFT IS THE NYMPH OF THE MAY FLY *EPHEMERA VULGATA*, AND BESIDE IT IS ITS EXUVIA OR CAST-OFF SKIN. THE THREE SMALLER FORMS ARE THE FLAT NYMPHS OF THE MAY FLY *BÆTIS*.

HOW TO KNOW THE WILD FLOWERS

By the REV. H. PUREFOY FITZGERALD, F.L.S.

With Photographs by HENRY IRVING

THE FLOWERS OF THE CORNFIELDS

CORN MARIGOLD

ONE of the most conspicuous amongst the cornfield flowers is the yellow Ox-eye Daisy (*Chrysanthemum segetum*). It is a plant that cannot well be mistaken for anything else, the bright yellow, daisy-like flower, about two inches across, will be sufficient for its identification. The Marigold is a troublesome weed to the farmer, coming up, as it does very frequently, in large numbers amongst the corn. In height it is usually about twelve inches, sometimes more; the lower leaves are stalked, whilst the upper leaves clasp the stem, and generally they all have a few coarsely cut teeth at the top. An examination of the flower will soon reveal that the Marigold is one of the composite plants, in which the flowers consist of a large number of small florets collected into one head. This plant is to be found in flower from June to September. Another well-known member of the genus is the white Ox-eye Daisy (*Chrysanthemum leucanthemum*); this, however, has a far more extending range of growth. It is to be found chiefly growing in pastures or grassy banks, and in railway cuttings, and so cannot strictly be described as a cornfield flower. The florets of the ray in this species are white, and the disk only is yellow; the stems are hard and furrowed, while the leaves are narrow and coarsely toothed. In the north of England and Scotland the common Daisy is called the "Gowan" (signifying golden), and the Ox-eye Daisy is termed the "Horse gowan"; in England other common local

CORN MARIGOLD.

PLANT LIFE

DESCRIPTION OF PLANT—The Dandelion

(*Taraxacum officinale*)

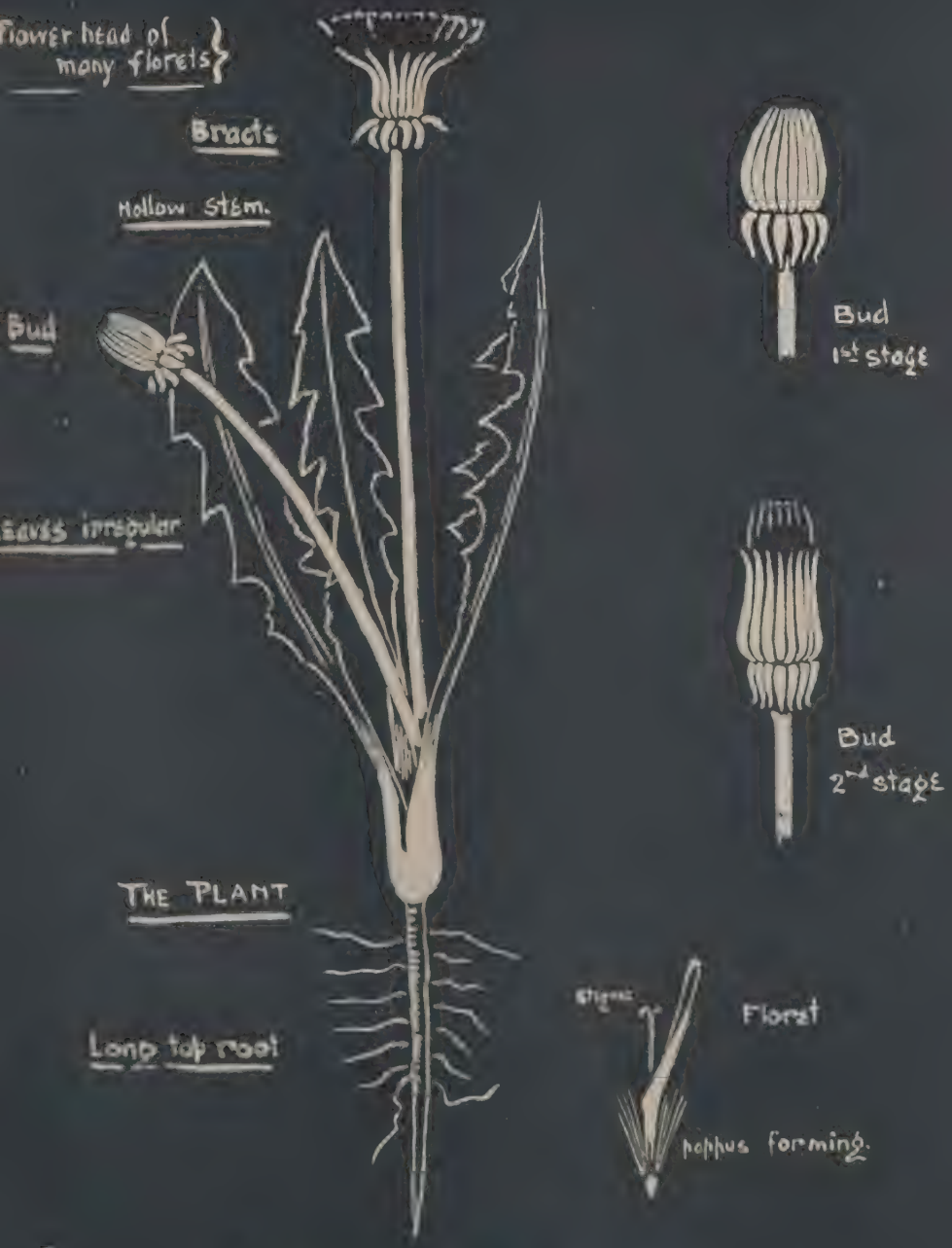
Specimens required :—PLANTS OF DANDELION

Examine the plant, noting the following points :—

1. *Root system.*—Long dark-coloured tap root with root hairs.
2. *Leaves.*—Irregularly shaped leaves, giving name to plant (*dent-de-lion*). Observe rosette habit of outer leaves.
3. *Flowers.*—The stems are hollow and contain a milky juice. The flower is composed of numerous florets (note calyx and bracts).

   3*a*. *Florets.*—Examine with lens, noting the two curved stigmas which form the pappus with seed case at base.
4. *Fruit.*—The seeds are contained in a seed case to which is attached a pappus. Thus seeds are easily dispersed by wind.
5. *Habitat.*—Meadows and waste ground.

Proceed similarly with other members of the Composite family—*e.g.* Daisy, Sunflower, Cornflower.



Taraxacum Officinale

names are Dog Daisy, Moon Daisy, and Maudlin Daisy.

OX-EYE DAISY.

CHAMOMILE

Growing amongst the stubble, after the corn has been cut, and also in waste places, two or three other daisies may be found, the flowers of which resemble those of the Ox-eye, but are not quite so large, and the leaves are pinnate, with narrow lobes. It may be difficult to distinguish between these, as there are three or four plants, closely allied, and very similar in appearance. The Corn Chamomile (*Anthemis arvensis*) flowers from May to August or September, the plant is more or less covered with small silky hairs. The Stinking Mayweed (*Anthemis cotula*) has smooth leaves, which bear small glands secreting a very nasty smelling and acrid juice; the unpleasant smell that arises when the leaves are bruised will help to identify it. The Common Chamomile (*Anthemis nobilis*), on the other hand, emits a very pleasant scent when it is bruised. This is the plant that was formerly used very largely for medicinal purposes; Chamomile tea was—and is now with some country folk—a favourite remedy for indigestion.

The Scentless Mayweed (*Matricaria inodora*), another of these closely allied and very similar flowers, has its leaves much more finely cut than any of the others, and the flower head is generally larger.

CORNFLOWER

The Cornflower (*Centaurea cyanus*) is a well-known plant in gardens, with blue, pink or white flowers that may be relied on to reappear each year where it has once been planted, as it seeds in a prolific manner. In the cornfields the florets of the disk are small and purple in colour, whilst those of the outer rays are fewer but larger, and of a brilliant blue. The plant grows to the height of about two feet, with single flower heads at the ends of long stems; these latter are very tough and wiry, are slightly angular in shape, and covered with a cottony down. Their wiriness is the origin of the local name "Hurt-sickle"; another common name is the "Corn Blue-bottle," the blue coming from the bright colour of the flower, and the term "bottle" because of a somewhat fancied resemblance of the scaly involucre just below the florets to a bottle or flask. The upper leaves of the Cornflower are arranged alternately on the stems, and are long, narrow, and with entire edges, coated with a downy substance: the lower leaves are broader and very often have somewhat rough toothed edges. The flowers may be found in the cornfields from July to September; it cannot be called a very common plant, as it is somewhat local.

CORNFLOWER.

THE POPPY

The flowers of the cornfields provide representatives of the three primary colours. The Cornflower gives us the blue, the Marigold the yellow, whilst the Poppy is of a brilliant rich scarlet. It sometimes grows so profusely that acres of fields, from a little distance, appear of this intense colour in June and July. The Corn Poppy (*Papaver Rhœas*) is an erect annual, frequently nearly two feet in height, with firm stems covered with stiff hairs; the lower leaves are large and graceful in form, with long stalks; the upper leaves appear on the stems with no stalks. Each of the four petals has a dark purple spot, or eye, at the base, and all are very delicate in texture; whilst in the bud the flower heads are bent over and the petals are tightly curled up and entirely covered by the two sepals of the calyx. These separate as the flower begins to expand, and finally fall off altogether. The Poppy does not secrete any honey, but insects are attracted by the quantity of pollen contained in the numerous stamens which form a dark ring round the pistil. This latter is a very conspicuous object in the centre of the flower, being crowned by a disk from which the stigmas radiate from the centre. This forms a very convenient platform for insects to alight upon, and if they have previously visited another Poppy flower and have been dusted by the pollen, some of this is sure to be transferred to the stigmas, and so effect cross-fertilisation. The fruit is globular in shape, and the seeds, which are very numerous, escape from small openings which appear in due time beneath the stigmas. All members of the Poppy family secrete a milky, syrupy liquid, which is more or less narcotic in nature; the species which provides the Poppy heads used for fomentations is the same as that from which opium is extracted (*Papaver somniferum*).

THE BINDWEED

The Corn Convolvulus, or Bindweed (*Convolvulus arvensis*), is a most troublesome weed to farmers, for the roots go very deeply into the soil and spread rapidly, so that it is a very difficult plant to exterminate. The name comes from the Latin *convolvo*, meaning "I twine around," as the whole plant twists itself round any slender support that happens to be near it. The flowering period extends from June till well on in the autumn. The petals vary in colour, being white with pink veins, or wholly pink. They are very sensitive to light and warmth, expanding rapidly when the conditions are favourable, but closing when picked. The flowers secrete a large amount of honey at the base of the stamens, which are slightly flattened out, so that the bee can only reach the honey by pushing its proboscis well down between them. In the act of doing this it comes in contact first with the stigma and then

with the anthers, so that the pollen which adheres to it on a visit to one flower will only be transferred to the stigma of the next which is visited.

CORN BIRD'S-EYE

The bright blue Speedwell, or Bird's-Eye, which grows in the cornfields is *Veronica agrestis*. It is to be found in most waste, and also cultivated places. Another species which resembles it closely, except that it is much larger in all its parts and of almost a brighter blue, is Buxbaum's Speedwell (*Veronica Buxbaumii*), which is not really a native plant, but it has spread very widely. The corolla of all the members of this genus consists of four petals, two large and two small, and it falls off, in one piece, almost as soon as the plant is shaken or picked.

FLAX

It is curious that the cornfields provide us with so many blue flowers—the colour that is most uncommon. The Flax, or Linseed (*Linum usitatissimum*), is another instance. It is not a true native of this country, but it has spread rapidly. The Flax is a very graceful, slender plant, quite smooth in appearance and branching towards the top; the leaves are found alternately up the stem, whilst the flowers are in a loose corymb; that is to say, the flower stalks start from different places up the stem, but the flower heads are all on the same level.

THE PANSY

The Wild Heartsease, or Pansy (*Viola tricolor*), is the parent of all the beautiful garden varieties now in cultivation. It is to be found elsewhere

SCARLET POPPY.

FLAX.

than in the cornfields, and wherever it appears is always welcome. The colour is very variable, being either purple, whitish or yellow, or even a mixture of all these. The shape of the flower will at once mark it as being one of the Violet family, and the general arrangement, which is somewhat of a complicated nature, ensures that it cannot be fertilised by its own pollen, insect visitation being necessary. This plant is very variable in its habit of growth. The name Heartsease was originally applied to the Wallflower, a certain medicine being made from these plants for heart affections, and Prior asserts that as the Pansy and Wallflower were both included among the Violets, it is easy to see that the name was transferred from the one to the other. The same author states that the origin of the name Pansy is obscure, and also gives many curious local names for the plant, such as Herb Trinity (from the three colours being often found in the same blossom), Cull-me, Love-in-idleness, Kiss-me-at-the-garden-gate, all of which are suggested by the coquettish hanging flower, with its half hidden face.

H. PUREFOY FITZGERALD.

BINDWEED, OR CORN CONVOLVULUS.

THE SPECIAL PROTECTIVE RESEMBLANCE OF GEOMETER CATERPILLARS TO TWIGS.

Two of their silken threads—they use these as stay-ropes when resting—can be seen between the two main branches.

BRITISH INSECTS

Some Notes on their Forms and Colours

By DOUGLAS ENGLISH, B.A., F.R.P.S.

With Photographs by the Author

IT is, I imagine, generally supposed that we have no native insects which can compare either in brilliancy of colouring, in quaintness of form, or in perfection of defence, with the insects which are peculiar to tropical countries. This view is unduly pessimistic. One need only use a sweep-net in May or June to discover that the supposed inferiority of our native insects is merely an inferiority in size. One need only employ a pocket lens on the produce of the sweep-net to realise that we have in every field and wood, aye, and in every patch of grass, a supply of grotesque forms, of brilliant colourings, and of marvellous adaptations, which is practically inexhaustible. Let the reader, who has not already done so, suitably illuminate and examine one of the emerald or turquoise Weevils which swarm on the whitethorn in June; let him feast his eyes on a scarlet-clad Hemipteron, or on that exquisite little Tortoise Beetle, whose wing-covers are banded with gold-green ribbons and edged with sea-shell pink; let him study one of the lilliputian Moths, those wisps of fluff and spangle, which flit from leaf to leaf of every hedgerow—and he must assuredly admit that the museums have nothing more beautiful to show him. Nor need he confine himself to microscopic forms. Let him consider such resplendent British insects as the Tiger and the Rosechafer among Beetles, the Sulphur and the Peacock among Butterflies, the Hoverflies generally, the Dragon flies, and, perhaps most brilliant of all, that small but matchless Hymenopteron *Chrysis ignita*—the "Fire of Gold."

That brilliancy of colouring must serve some purpose in Nature's economy is certain, but there is no certainty as to

A REMARKABLE INSTANCE OF AGGRESSIVE MIMICRY (ALLURING COLOURS), AFFORDED BY A SPIDER OF THE GENUS *THOMISUS*.

This spider mimics both in colour and form the unopened bud of the bramble.

the precise benefit which any particular colour-brilliancy confers on any particular insect. A sombre habit, which harmonises so closely with the insect's normal surroundings as to make it practically invisible at rest, may be explained as a result of natural selection. Insects which are so protectively coloured as ordinarily to escape the notice of their enemies, must, we imagine, have a better chance of survival than insects which are markedly conspicuous. If we are right in assuming that dull-coloured insects have been benefited in the struggle for existence by their invisibility, we must also be right in assuming that brilliantly coloured insects have been prejudiced by their visibility, and we must, in their case, look for some additional means of defence which has enabled them to survive in spite of a severe handicap. The theory of "warning colours" though it cannot be said to resolve the difficulty completely—the final word must come from observers in the field rather than from experimenters in the vivarium—has at least furnished us with a useful working hypothesis. According to this theory a brilliant colour scheme (the black and yellow banding of the Wasp for example) is associated with some noxious quality (the Wasp's sting in this instance), and *serves to advertise the existence of that quality to all whom it may concern.*

At first sight it would appear that "warning" colours can only benefit the prospective enemy, and that they cannot therefore in any sense be the result of

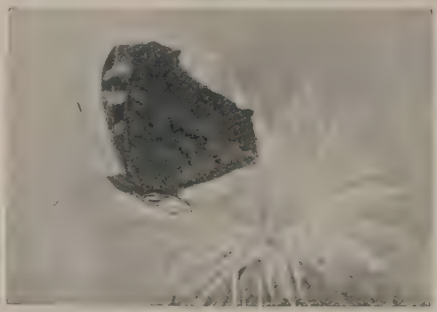
natural selection. It has been argued, however, that though the individual conspicuous insect may be martyred on occasion by reason of his conspicuousness, his martyrdom must be regarded as highly advantageous to his relations. A young bird or lizard, for example, may, and probably does, in the callow stage sample Wasps and yellow-and-black Caterpillars. The sting of the former, however, and the nauseous taste of the latter, linger in his memory, and four or five experiments determine him to avoid yellow-and-black victuals altogether. Were Wasps and, say, Cinnabar Caterpillars protectively coloured, the young bird or lizard would, for the want of any means of distinguishing them from wholesome food, continue to be stung and to be made sick, both to his own disadvantage and to the disadvantage of Wasps and of Cinnabar Caterpillars generally. Though black in combination with red-brown, yellow, or orange is the most obvious form of "warning" coloration, it must be remembered that the theoretical purpose of "warning" colours is a conspicuous advertisement of the owner's disagreeable qualities, and that this advertisement may be effected by any colour, or by any form, which is markedly dissimilar from, and so markedly in contrast with, its normal surroundings. The whiteness, therefore, of White Butterflies, the metallic patches on many chrysalides, the aggressive hairiness of "Woolly Bears," and the devil-may-care publicity of gregarious Caterpillars, may each and all be danger signals.

TWO REMARKABLE DEFENSIVE ATTITUDES ADOPTED BY BRITISH CATERPILLARS.

1. The Puss Moth Caterpillar extruding filaments from the projections on the hind part of his body, and telescoping his front segments to show his eye-markings.
2. The Lobster Moth Caterpillar, mimicking spider.

It is a matter of some difficulty for the field naturalist to reconcile his own experience with the experimental proofs of the warning colour theory which have been conducted in the vivarium. He has seen Ichneumon Flies attack brilliantly coloured Caterpillars in the open; he has seen birds and lizards eat black and yellow insects, not with "evident signs of disgust," but with evident signs of satisfaction. He knows that the most flamboyant combinations of colour vanish amid suitable surroundings; that they are on occasion at least as protective as sombre colours; and that their protective character is due to their brilliance. Experience has taught him that in his own quest for food he conforms to definite conventions — he would have to be extremely hungry, for example, before he ate a sandwich which he found lying in the road—and he is inclined to suppose that insectivores among the lower orders may perhaps have conventions of their own, which make them diffident of eating anything, no matter what its colour is, which is not in such a situation as their food is usually found in, or behaving in such a way as their food usually behaves. This, in his judgment, accounts sufficiently for the fact that birds who are accustomed to hunt for caterpillars under leaves, look askance at an assemblage of Cinnabar Caterpillars naked and unashamed on

defoliated ragwort; and that Sand Wasps, who have had their paralysed prey taken away from them, will often give themselves the trouble of finding a fresh victim rather than recapture one which now shows none of the conventional signs of resentment, and must therefore be regarded as sick and unfit for Wasp consumption. The field naturalist, then, is likely to acquire the conviction that, given harmonious surroundings, any colour or combination of colours may be protective, while, if the surroundings are not harmonious, any colour or combination of colours may be conspicuous; and he will account for the persistence and comparative immunity of brightly coloured insects which expose themselves freely, by arguing that the immunity may be closely connected with the exposure itself, since insectivores generally show marked preferences as to the kind of food they wish to find and as to how they wish to find it. It is noticeable in this connection that the chief enemies to wasp-like Flies are the Wasps themselves, who frequently take them on the wing, but who seldom, as far as my own experience goes, take them when settled and at rest.

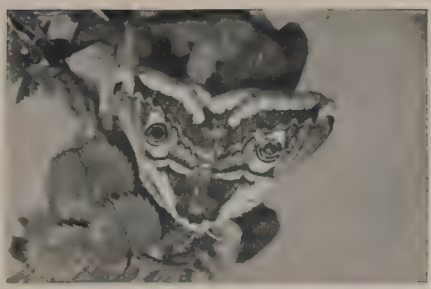


A TYPICAL BRITISH *VANESSA*, THE PEACOCK BUTTERFLY, WHOSE WINGS ARE WARNINGLY COLOURED ON THE UPPER AND PROTECTIVELY COLOURED ON THE UNDER SURFACE.

Warning colours appear to afford but little protection to such of our bright-hued insects as survive the winter. The queens of the social Bees and Wasps select not only sheltered but concealed situations to lie up in. The wings of our hibernating Butterflies are almost without exception "warningly" coloured on the upper surface, and protectively coloured on the under surface. It is the latter surface only which is exposed while they are hibernating. In most Butterflies one can trace on the under surface of each lower wing a tendency for the darkest portion to be nearest the insect's body, and for the remainder of the wing to be broken up with transverse ribbon markings across the centre, and chequerings on the outer border. The result of this arrangement is that with a suitable background the external outline of the wing is lost altogether. There is, in fact, an imperceptible softening away of the wing from the portion nearest the body outwards, while the body itself, which in the normal sleeping position is uppermost, is in most cases in the shadow of the support to which the insect is clinging. One can hardly doubt that the exceptional coloration of the under surface of the wings of the Large Copper (there was a broad warning orange band close to the outer border and following its contour) may have helped towards this handsome insect's extinction.

Though the theory of warning colours cannot be said to have won universal acceptance, it has nevertheless compelled universal attention, and mention must be made of a variation of it, which is due to Dr. Eisig. As the result of his investigations in connection with a small

group of Marine Worms, this biologist holds that brilliant pigmentary colours are the *cause* of the unpalatability of certain species, and that therefore they cannot have been evolved as an advertisement of that unpalatability, though they may, in time, have come to act as an advertisement. It is conceivable that not only pigmentary colours (orange, brown and black mostly) but also structural colours (metallic blues and greens mostly) may have their origin in some form of excretion, and on this ground Dr. Eisig's emendation of the original theory has gained considerable support.



TWO EXAMPLES OF PROTECTIVE MIMICRY IN THE FORM OF EYE-MARKINGS.

1. The female Emperor Moth. 2. The Caterpillar of the Large Elephant Hawk-Moth. The latter when alarmed retracts the front segments which carry the true eyes, and assumes the terrifying appearance seen in the picture.

One thing seems indisputable—that non-sexual brilliancy of insect colouring, whatever purpose it may be serving at the present, must have long since disappeared if it had not served some definite purpose in the past. This being so, we can, whatever be our opinions as to the exact meaning of non-sexual brilliance, admire without misgiving the fascinating theory of "protective mimicry." It is unfortunate that in natural history the word "mimicry" should have acquired a restricted meaning. It is a word which has no convenient synonym, and whose connotation should have been left wide. It might have embraced, to the convenience of reader and writer alike, all such natural simulations and dissimulations, special and general, constant and variable, as enable living organisms to appear to be what they are not.

"Protective" mimicry, however, was the term employed by Bates in his classical paper contributed to the Linnean Society's transactions in 1862, to denote such simulations of shape and colour as enable a harmless unprotected form of life to derive advantage in the struggle for existence from its resemblance to a harmful or protected form. Strictly speaking, then, "protective mimicry" is a highly specialised branch of that protective resemblance to surroundings which influences the whole existence of the lower orders, and which forms their most powerful weapon.

In the same way "aggressive mimicry" is a highly specialised branch of what is termed "aggressive resemblance." For a full understanding of the modern classification of protective and aggressive resemblances in Nature I must refer the reader to such a book as Poulton's "The Colours of Animals," and I must content myself here with a brief résumé of this classification, and with a few comments on the photographs which I have selected as illustrations of it. It should perhaps be pointed out that, as far as protective or aggressive resemblance is concerned, it is of the essence of a good photograph that it should be something in the nature of a puzzle picture. Professor Poulton defines protective resemblance as "concealment as a protection against enemies," and subdivides it into general and special protective resemblance. The former is a colour protection only, while, in the latter, form as well as colour are

embodied; either may be constant or variable. I have already given examples of constant protective resemblance in the case of the under surfaces of Butterflies' wings, and I need not dwell further on this subdivision. Good examples of variable protective resemblance are to be found amongst vertebrates. The Chameleon is perhaps the most notorious, but most fish and amphibians exhibit the power of varying in tint so as to conform to their immediate surroundings, and many northern animals change colour with the season. In the case of insects it is the Lepidoptera which have been chiefly studied. There appears to be no certain case of a Moth or Butterfly changing its skin, or its spots, after it has once reached the imago stage, but in the larvæ of Lepidoptera, and in such pupæ as are exposed to the light of day, variation to suit a change of environment is extremely common. Where protective resemblance becomes so specialised as to include form as well as colour, the insects provide us with unique examples, but the greatest care must be exercised to prevent our enthusiasm outrunning our discretion in considering what is or is not a true example of such specialised resemblance. In such cases as the Geometer caterpillars, and the caterpillar and chrysalis of the Purple Emperor, it cannot be reasonably doubted that there is a distinct and specialised resemblance between the insect and a portion of its natural food plant, but in the case of the Orange-tip Butterfly, whose exquisitely chequered wings have led to its being depicted times out of number asleep on the Wild Parsley, I venture to submit that beyond a coincidence of form and colouring there is no evidence whatever to establish the connection. The umbelliferous plants are singularly attractive to Flies and day-flying Beetles, and singularly unattractive to Lepidoptera. The pattern of the under surface of an Orange-tip's lower wings would conceal it in almost any outdoor situation. I would say much the same of the Brimstone's wings, though I am free to confess that the resemblance between the Brimstone asleep and a young holly leaf is, as has been pointed out by Mr. Kay Robinson, a remarkable one.

The most amazing forms, however, of specialised protective resemblance come under the heading of protective mimicry. One can hardly help regarding protective mimicry as an immoral phenomenon. It is so hopelessly commercial. It is as though one donned a policeman's uniform in order to stand in front of the crowd. The most evident examples of noxious insects in this country are the Stinging Hymenoptera, and there are countless stingless insects which mimic Wasps and Bees, both in coloration and in form. Humble-bee Flies, for example (*Bombyliidæ*), are familiar enough to those who study the woods. They are early, short-lived insects (May-June), and may be seen hovering with a characteristic and unmistakable flight—I have been told that it closely resembles that of a humming-bird, and that the illusion is helped by the length of the fly's proboscis—over some particular patch of ground which takes their fancy. To this they return again and again. In spite, therefore, of the enormous speed and decision with which they change course—I have seen one describe a complete circle flying inside a 1½-inch pill-box—they are easily caught. On examining them in the hand, one is at once struck by their flimsiness. Their legs seem hardly to support them, and their weak-kneed appearance is singularly out of keeping with the impression of strength and fussiness which one gathers from observing them in flight. Before rising in the air Bombylius brings his wings into action by a curious manœuvre. He deflects them suddenly at right angles to their position of rest and imparts to them an extremely rapid up-and-down movement. Viewed from above at this stage they present the appearance of two rigid black bristles, and are practically invisible against a dark background. As he warms to his work, the extremities of his wings vibrate in "figures-of-eight" in front and in rear of the perpendicular plane, and give one the impression of "buzzing." It is to their fussiness, I fancy, rather than to their colouring that the Humble-bee Flies owe their popular title. So far as colouring is concerned a far closer approach to the Humble-bees is afforded by Flies of the genus *Volucella*. These have no long

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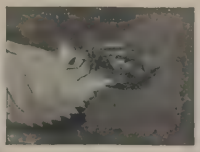

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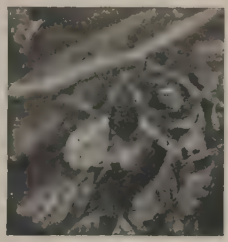

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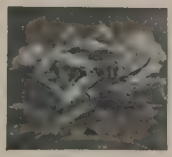

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EXAMPLES OF THE PROTECTIVE MIMICRY OF STINGING HYMENOPTERA BY VARIOUS ORDERS OF BRITISH INSECTS.

1, 2. The Humble-bee Fly *Bombylius* (mimicry of Bee).
3. A Smooth-bodied Fly, *Volucella inanis* (mimicry of Wasp).
4. A Smooth-bodied Fly, *Syrphus* (mimicry of Wasp).
5. The Wasp Beetle *C. arietis* (mimicry of Wasp).
6, 7. The Hornet Clear Wing Moth (mimicry of Hornet).
8. A Hairy-bodied Fly, *Volucella* (mimicry of Humble-bee).
9. A Large Saw Fly, *Sirex gigas* (mimicry of Hornet).

proboscis, and are built on stronger lines than the *Bombyliidæ*. Unlike the latter, they frequently settle. Their resemblance of certain species to the Humble-bees, both in furriness of body and in colour arrangement, is remarkable. Some are clothed with red hair at the extremity of the abdomen, and so mimic *Bombus lapidarius*, the common Fire-tailed Humble-bee; others are banded with sulphur yellow and so resemble *Bombus terrestris* or *Bombus lucorum*. Smooth-bodied *Volucellæ* often resemble Wasps, *V. inanis* being a good example. We shall recur later to the fact that in *Volucellæ* the mimicry is not only protective, but aggressive.

AN OFTEN QUOTED EXAMPLE OF "WARNING COLORATION."

The black-and-yellow caterpillar of the Cinnabar Moth on its food-plant Ragwort.

To turn for a moment to other orders of insects we find instances of a presumably beneficial protective mimicry in the Clear Wing Moths—I give illustrations of the Hornet Clear Wing—and in several Beetles, notably the common Wasp Beetle (*C. arietis*), who, as Professor Poulton has pointed out, exhibits, in addition to wasp-coloration on the body, a decidedly waspish character in the shape and movements of the legs. In all the above instances the simulation is of stinging Hymenoptera, but protective mimicry has an almost unlimited range, and may exist between creatures not only of different orders, but of different classes and even of different sub-kingdoms. Eye-markings are a case in point, and I would leave my illustrations to give some idea of the terrifying aspect which these harmless arrangements of colour can produce, more especially when, as in the case of many Caterpillars, they are combined with snake-like attitudes. It would appear that the suggestion is that there lurks behind the "eyes" a vertebrate body of a size to correspond with them. Spiders, again, and Ants, appear to be in themselves such effective "bogies," as to deserve the closest possible imitation in form. The caterpillar of the Lobster Moth on hatching from the egg closely resembles an ant. When full fed his terrifying attitude—he throws back his head and brandishes four skinny legs—bears an extraordinary resemblance to a spider, and, it can hardly be doubted, must often intimidate an Ichneumon Fly.

From protective resemblance, which, strictly speaking, merely effects concealment, we pass through its specialised form "protective mimicry," which deceptively suggests danger, to aggressive resemblance, defined by Professor Poulton as "concealment in order to effect attack," and to its offshoot "aggressive mimicry." Under the latter heading come appearances which "deceptively suggest some object attractive to prey (alluring colours), or which enable an enemy to approach without exciting suspicion (aggressive mimicry proper)." I am pleased to be able to present an example of "alluring colours," which I believe has not hitherto been published, in the case of a Spider of the genus *Thomisus*. This Spider (*T. citreus*) often mimics to a nicety both in form and colour the buds of the bramble, and the fly seen in some of the illustrations had, immediately before the photograph was taken, actually perched on the back of "his bitterest foe," but had found him inedible. Of aggressive mimicry proper we have an excellent example in the *Volucellæ* already referred to, whose wonderful simulation of Humble-bees enables them to enter the nests of the latter and deposit their eggs there. Their larvæ feed on the food stored by the Bees, or even upon the Bee larvæ. *Volucella inanis* is said to have similar designs on Wasps' nests.

THE BROOKLIME AND THE MINT.

CHAPTERS IN PLANT LIFE

VI—THE PLANT AND ITS ENEMIES

By S. LEONARD BASTIN

With Photographs by the Author

NATURE is, often enough, careless as to the fate of the individual, provided the perpetuation of the race is well assured. There are few instances in which this is so well seen as in the case of many of our common weeds. A considerable number of these species are peculiarly liable to the attacks of animals from which they seem to be ill-protected, yet these plants are always to be found in the greatest abundance. As a matter of fact, the race persists in flourishing, either by sheer vigour of growth or owing to the ease with which the species can reproduce its kind. The amazing vitality of the grasses is an excellent illustration of those plants which within reasonable limits are almost indestructible. For ages the grasses have served as the mainstay of the grazing animals, yet there are few more prosperous species. From the underground stems which so many of these plants produce, a constant supply of green tufts can be sent up to replace those which have been torn away. In the case of the Groundsel or Chickweed the continuance of the race is assured by the facility with which the little plant can reproduce its kind. Both these species seem to be harmless and sweet-tasting, such as the larvæ of insects, as well as snails and slugs, would delight to feed upon. Yet it is well known that these plants are among the most troublesome pests of our gardens. This is simply owing to the fact that both the Groundsel and the Chickweed come to maturity so quickly, that it is not an uncommon thing for several generations to be brought to perfection in a single season.

The entire animal kingdom lives at the expense of the vegetable world, and to protect the plant against the aggressors

CACTUS THORN.

many remarkable devices have been called into being. One of the most widespread contrivances for the defence of the plant is the thorn. These spines are very prevalent among many genera, and in the different species represent modifications of both leaves and stems. The development of the thorn is seen to a remarkable extent in the case of the Cacti, plants which in some ways are more perfectly protected than any others in the world. With many species, particularly among the groups Echinocactus and Melocactus, the whole plant is covered with spines, which interlace in such a way that no part is left unshielded. A kind of Prickly Pear, well named *Opuntia formidabilis*, produces thorns which are sometimes as much as a foot in length. The desert in which these plants grow is peopled with a comparatively sparse vegetation, and the juicy stems of the plants would be peculiarly liable to be attacked by hungry and thirsty animals. Indeed, even with its armament of thorns, the Cactus is not absolutely secure. It is said that the Mexican ponies have learnt the art of kicking away the spines with their heels, and then slaking their thirst at the bleeding wounds inflicted.

It is a very significant circumstance that the production of spines seems to take place to the greatest extent when the plant is growing under adverse conditions. In this connection an exceedingly interesting species is the Rest Harrow (*Ononis arvensis*). As is well known, this plant is to be found fairly common in two varieties, called respectively *O. spinosa* and *O. inermis*. As is implied by the name, one plant is thorny and the other is quite devoid of any spines. Now and again both these varieties may be found growing in the same district, sometimes quite close to one another. It will be seen, however, that the thornless specimen has been more fortunate in its position than the one which is well clad with its defensive armament. In the former instance the little plant has lighted upon a patch of moist, rich soil; whilst in the latter case a hard struggle for existence, in a dry situation, has been the fate of the subject. It is very commonly to be seen that a race of one-time thorny plants will, under cultivation, tend to get away more and more from their spiny character. As domestic subjects, the plants, removed from the fierce fight in the natural world, are no longer in need of protective devices.

Although in many cases serving the same purpose, the prickles often seen upon the leaves and stems of plants are on different lines from thorns, seeing that they are merely excrescences of the cuticle. The hooked prickles of the Briar Rose peel off with the skin and are quite unattached to the woody portion of the stem. In the Holly, the prickles are to be found springing from the margin of the leaves. It is curious that it is only whilst the Holly is in its shrubby form that the leaves evidence their prickly nature. As soon as the plant attains to the dignity of a tree the foliage is produced with its margins quite unbroken. In many large bushes, it is possible to trace the process by which the prickles have been gradually discarded; and from a single shrub an interesting series of leaves may be

gathered, commencing with the specimens from the lower branches, which are fully armed, and ending with those from the uppermost shoots, which are quite destitute of any prickles. As in the case of the thorny plants, it is to be noticed that prickles are produced in the greatest abundance when the specimen is having a hard time of it. Thus Briar Roses which have been cut back in hedges send up their fresh shoots abundantly supplied with prickles.

Closely allied to the prickles are the various hairy appendages which are so often distributed over the foliage of plants. The leaves of the Orange Hawkweed, and even the flower stems, are covered with stiff black hairs. Plants protected in this manner are not subject to the attacks of insect larvæ, slugs or snails, as would be the case if the foliage were perfectly plain. Similarly, grazing animals are less inclined to regale themselves on leaves which are thickly covered with bristles.

There must be few people who have not suffered at one time or another through coming into contact with the stinging hairs of the Nettle. Under the microscope it is seen that these stings consist of a long tapering cell, rising from a cushion-like base. The point of the hairs is easily broken, owing to the cell wall being very thin. When the hair comes in contact with any object which the apex can pierce, a slight wound is made, and at the same time the upper part of the bristle breaks, allowing the fluid which the cell contains to escape into the opening. The poison, consisting as it does of formic acid and a property known as enzyme, is of a peculiarly irritating nature—as most people will have experienced to their cost.

Far more formidable, however, are the stings of certain exotic species, one of which, the great Shrubby Nettle (*Urtica crenulata*) of Northern India, is a really formidable plant. This species attains

INK-BOTTLE OR URN-SHAPED FLOWER OF THE WHORTLEBERRY, ESPECIALLY DESIGNED TO EXCLUDE CREEPING INSECTS.

to the height of fifteen feet, and is described by Sir Joseph Hooker as having broad glossy leaves covered with microscopic hairs. The plant only seems to sting violently in the autumn, but at that time the strength of the poison is such that people have suffered from its effects for days. Moreover, at the time of its greatest activity the plant gives off an effluvia which is so powerful that it causes running from the eyes and nose. More formidable still is the *Urtica gigantea* of Australia, which grows into huge bushes twenty feet or more in circumference. It has been pointed out by Mr. Edward Step that in the foliage of the Common Elm very similar processes to the stinging hairs of the Nettle are to be observed. These are nothing like so formidable as those of the Nettle, but are sufficiently so to cause an annoying irritation to the hands. Of course, the Elm is classed with the same natural order as the Nettle. It seems likely that these stinging hairs serve a real purpose in protecting the young growths of the Elm just at a time when they would be most likely to be damaged by grazing animals.

A singular development is that to be seen in the case of the Cuckoo Pint (*Arum maculatum*). In this case the tissue of the foliage contains thousands of little crystal needles (in addition to a certain acrid poison) which stick into the lips, causing an intolerable burning sensation. This fact may be proved by anyone biting a small portion of the leaf. Whether these crystals are really a protective measure or not, there is no doubt that the plant must often be left alone on account of their presence. The crystals are developed to a much greater extent in the case of certain tropical plants allied to the Arum.

There is little doubt that the development of sour and poisonous juices in certain plants is valuable as a protective measure. This is not invariably so, for certain products such as the tannin in the Oak are merely waste products—the outcome of a definite chemical process. Still, in the case of many species it is clear that the plant derives a distinct advantage from its offensive juice, and we can hardly regard its presence as entirely accidental. If we take the strong-tasting plants of the countryside—the aromatic Mint, the pungent Water Cress, the evil-smelling Jack-in-the-hedge, to mention only three examples—we shall assuredly find that these species enjoy a comparative immunity from attack. True enough, as if by way of retaliation, certain insect larvæ seem to have developed a special fancy for some of these species; but, as a rule, the mild-tasting vegetation is much more likely to receive the attentions of marauders.

NETTLE STINGS (MAGNIFIED).

A very interesting problem which arises in connection with certain species of plants which seem to be specially protected is that of mimicry. The subject is one concerning which we have little positive knowledge, yet some of the instances are so striking that they cannot well be ignored. On the face of it there is, of course, nothing preposterous in the conception of plant mimicry, when we have so well established a theory on the same lines in the case of animals. The common Mint of our brooks, a particularly attractive plant, which sends up lusty shoots in the

early summer, is but rarely attacked, doubtless because of its strongly aromatic flavour. Now just at this time the Brooklime, another moisture-loving plant, starts to grow. These two plants, both found plentifully in damp spots, frequently intermingle; and at a little distance it is not an easy matter to distinguish the one from the other, so strong is the resemblance. It does not seem unreasonable to suppose that the Brooklime benefits to some extent by its resemblance to the Mint. Grazing animals cropping the herbage along the banks of the brook, would be likely to leave a plant severely alone which looked so like the aromatic Mint. Lord Avebury has pointed out the close similarity existing between the Scentless Mayweed and the Chamomile, both as regards leaves, flowers, and general habit. The latter species has a strong bitter taste which is likely to serve as a protection, and in its resemblance the Mayweed may possibly reap advantage. Of course, these last two plants are so closely related to one another that one should not perhaps attach too much importance to the likeness.

Far more remarkable than the instances of possible mimicry already mentioned are the large number of plants bearing a more or less striking resemblance to the Stinging Nettle, which, we must remember, is one of the best protected species in this country. This simulation is seen to its greatest advantage in the case of the so-called White Dead-Nettle (*Lamium*), a plant which is not even remotely allied to the Stinging Nettle. Especially is the likeness to be observed in the early stages of growth, before the white blossoms of the *Lamium* have been developed. Indeed, it is only after a critical examination that it is possible to tell the difference between the two plants, when, as is often the case, they are growing closely together. It is surely not an unreasonable supposition to suggest that browsing animals, and possibly even insect larvæ, may be deceived, and may pass over the harmless plant under the impression that it is the baneful one. At any rate, after a few experiences with the Stinging Nettle, one can hardly imagine an observant creature

HAIRS ON FOXGLOVE'S LIP TO EXCLUDE UNWANTED VISITORS.

venturing to meddle with anything that at all looked like the obnoxious weed. As has been suggested, there are quite a number of plants which bear a fair similarity to the true Nettle, such as the Red and the Yellow Nettle, the Betony, the Gipsywort. One can scarcely think that it is entirely chance which has ordered this remarkable repetition of one suggestive form.

Whether anything which may be called protective resemblance exists among plants is at present an open question, but certain succulent species are very curious in this connection. The most striking of these plants is *Mesembryanthemum truncatum*, a South African species which flourishes in desert regions. The whole of this quaint vegetable consists of succulent shoots which grow close to the ground, and these so strongly resemble the stones among which they nestle as to be most perfectly hidden. Even after a close examination it is impossible to distinguish the plant from the stones. Several allied species are also remarkable on account of their rock-like appearance, which, whether it be accidental or not, can hardly fail to cause the plants to be overlooked time and again. A few of the Cacti may also be said to bear a strange resemblance to their environment, most striking of all in this direction being the *Cereus monstruosus*. This plant, which produces oddly-shaped stems, is coloured in such a dull brown manner that it does not look in the least like a growing vegetable.

It is often in the very beginning of a plant's existence that the most need arises for protective means. It is therefore not surprising to find quite a number of seeds which may be regarded as examples of simulation. Doubtless many of these resemblances are purely accidental, but in others one cannot but think that there is a real purpose in the resemblance. Many seed vessels bear an astonishing likeness to beetles and other insects. In a leguminous plant which is called *Scorpiurus* the pods so closely resemble a scorpion that even an experienced eye is deceived at a distance. In the same way the seeds of the Castor Oil Plant (*Ricinus*) are very much like a small beetle, and the resemblance is still more strong in the seeds of some of the species of *Jatropha*. More remarkable than any of the instances mentioned above are the large seeds of the genus *Chelonospermum*, plants indigenous to certain of the Pacific Islands. These most wonderfully resemble the giant Coleoptera, which are such a feature of insect life in this part of the world.

One can well understand that granivorous birds, which would tear these seeds in pieces and destroy them, might mistake them for very formidable beetles, and thus leave them alone. In much the same way the smaller seeds might be left alone by grain-eating birds, under the impression that they were insects. In passing, it may be pointed out that in the case of these latter it might be an advantage for them to be swallowed by birds, provided that their external coating was able to withstand the action of the digestive juices. Thus the resemblance which they bear to small insects would make them attractive to insectivorous birds, and even if the winged creatures did not actually swallow the seeds, they would probably be sufficiently interested to carry them a little distance before the mistake was found out.

The good things with which the flower is stored are not intended for all comers. The matter is viewed in rather a different light, however, by certain insects who seem to regard the feast as having been specially prepared for their delectation. To ward off the attacks of these plunderers has called for no little ingenuity on the part of the plant. There is little doubt that the shapes of certain flowers have been modified largely for the purpose of excluding small creeping insects. The urn-shaped blossoms of the Whortleberry secrete their honey right at the base of the corolla, where it can only be reached by long-tongued insects. Even if a creeping visitor could negotiate the rounded sides, it would not be able to enter the flower, so narrow is the opening. Many plants bearing flowers in which the nectaries and pollen are fairly accessible, arrange to prevent creeping insects from getting near to the blossoms at all.

The stems of not a few plants are densely covered with minute hairs, which render it almost impossible for crawling insects to mount up to the flower. In

A WELL-PROTECTED CACTUS.

some instances the hairs all point downwards, and this is to be observed in the case of certain grasses; if the thumb and finger are moved up the stem a very perceptible roughness may be felt, which is absent when the stem is passed in an opposite direction. In other cases it is not until the visitor actually arrives at the flower that he is confronted with the barrier of hairs. In the case of the common Cornflower the stems and leaves are quite destitute of prickles, but the involucres forming the flower head are bordered with formidable teeth. The lip of the Foxglove is covered with long bristles which guard the entrance to the flower. These do not seem to trouble the humble-bees, which appear to be the only legitimate visitors to the flower. In the case of quite a number of plants, even the filaments of the stamens are clothed with hairs that form barriers in the way of tiny insects which would mount to the pollen-laden anthers. This is seen to a certain extent in the case of the Crocus, and to a much greater degree in the flower of the Bog Asphodel, where the stalks of the stamens are quite "furry" in appearance.

In a certain number of instances the presence of glandular hairs secreting a glutinous substance makes it difficult for creeping insects to get anywhere near to the centre of the flower. This is to be observed in the blossoms of the Gooseberry, and of the *Linnæa*. The calyces of the Plumbago and Honeysuckle are so thickly adorned with glandular hairs that small insects not infrequently get stuck fast when trying to approach the flower. This is seen to a much greater extent in the case of the *Silene nutans*, well named the Catchfly. Here the upper part of the stem, as well as the calyx, is viscid, and large numbers of small insects are to be found dead and dying upon the glutinous surface. Just at the time when the Rhododendron flowers are at their best the stem is peculiarly sticky by reason of a mucilaginous substance which is exuded. On this it is possible to find almost any number of little creatures which are captured whilst endeavouring to reach the blossom.

S. LEONARD BASTIN.

FISHES OF OUR SEAS

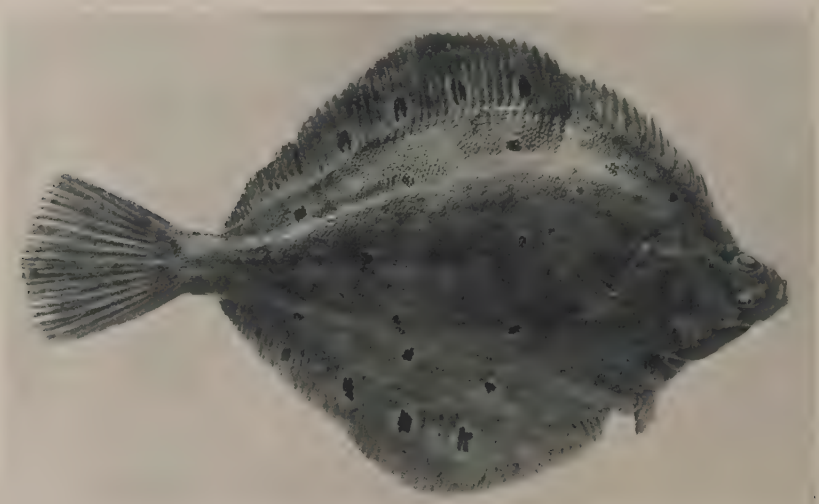
Their Shape, Size and Colour

By F. G. AFLALO

I—PLAICE, DORY AND GARFISH

FROM remote ages the sea has been peopled with fishes, some of which at a later period found their way first into rivers and thence into lakes. The sea, however, the home of all life, was the cradle of the race, and although most of the salt-water fishes which we know to-day have been developed from forms long since vanished in the mists of antiquity, a few, like the Port Jackson Shark, retain the general characteristics of very ancient types encountered only in the fossil strata, and more familiar to the hammer of the geologist than to the nets of the fisherman.

Even the fishmonger's shop, in which not one in a thousand of the known kinds of sea fish is ever seen, will reveal at a glance the curious differences in shape, size and colour. True, the largest and the smallest fishes in our seas—the basking Shark, which grows as long as forty feet, and the little Sucker, which never exceeds four inches—are never seen in the fish market. Yet there is a wide difference in size between the great Cod or Halibut and the tiny Whitebait (really young Sprats and Herrings) with which we often see it garnished. In the familiar Mackerel, Plaice, Dory and Garfish, too, we have four widely divergent types of living fishes, of which the first-named may be regarded as the most usual form of fish —the typical, torpedo-shaped, silvery, forked-tailed animal with scales and fins and gills. All fishes have scales and gills,



PLAICE.

though in a few, like the Australian "Lung-fish" and some of its relatives in Africa and South America, we also find an arrangement for breathing air direct instead of, as is done by the rest, using such air as is suspended in the water.

What a range of colour, too, we find even on the fishmonger's slab: the blue and silver Mackerel, the brown, red-spotted Plaice, the duller Cod and Whiting, the scarlet Gurnard, and many others. If, instead of confining our survey to the fishmonger's, we pay a visit to the museum in Cromwell Road, where Mr. Boulenger has got together a wonderful collection of fishes from all the world over, we shall be amazed by the extraordinary variety of colour, for some of the Wrasses, Dragonets, Gurnards and Mackerels, the Opah, and others too numerous to mention, are a perfect blaze of colour. It would appear at first glance as if such skins, which seem to be modelled on the gaudiest Turkey carpets, would make their owners too conspicuous to their enemies, as well as to the smaller fishes, which many of them have to catch for their living; but a little inquiry shows that many of the most brilliant inhabit tropical seas, where the fierce sunlight makes them, in fact, harder to see than they would be in duller coats.

As in birds, too, the male is sometimes more gaily dressed than the female. The gemmeous Dragonet is a well-known case of this difference between the sexes, and the female, a homely little thing beside her resplendent mate, was long thought to be a distinct kind of fish, and was always referred to as the Dusky Skulpin. There always has been a good deal of discussion among naturalists as to the meaning of these differences. Some are of opinion that the males display the brighter colours to be attractive to the females. Others hold that the females gladly wear quiet colours in order not to be seen during the time they are laying their eggs, a provision of Nature for the maintenance of the race. These are mere guesses, and both may be wrong. In any case, one opinion is as much entitled to a hearing as the other.

Not a great many of our sea fish are spotted, though spots are familiar in the Plaice and in the Common Dogfish. Still, a large number of other fishes bear spots when very young, just after leaving the egg. This is the case with young Cod, which may be compared in this respect with lion cubs, which are generally spotted at birth, though they lose their spots in course of time. Other fishes, like the Dory and Turbot, have a chameleon-like trick of changing their colour to suit their background, and the Wrasses, brilliantly coloured fishes that are of no use for the table, also possess this peculiarity.

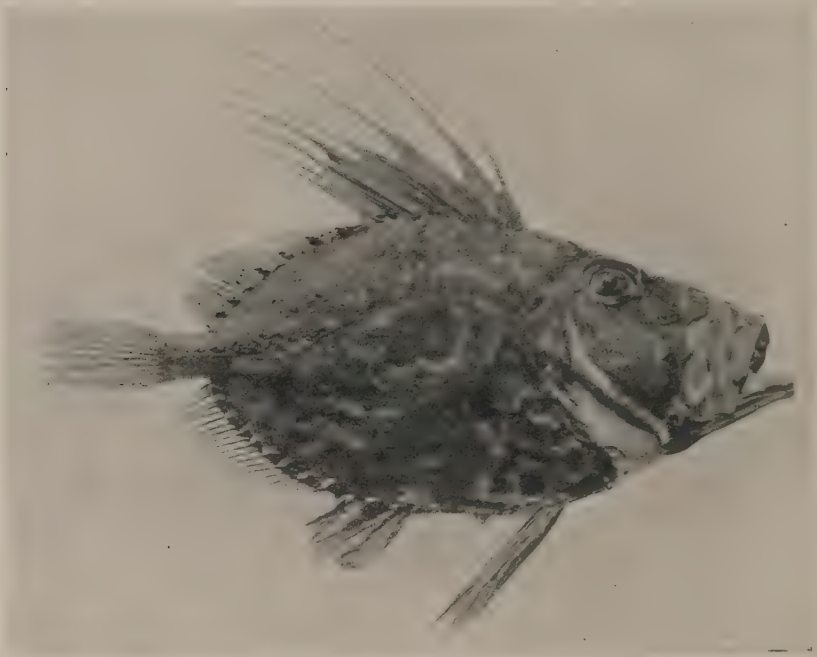
GARFISH.

Reverting for a moment to the shape of our British fishes, there are many remarkable types which are never seen at the fishmonger's, save occasionally as exhibits to attract buyers. There is the Sunfish, an extraordinary globular monster, which may weigh over 500 lb. There is the Swordfish, which is armed with a long bone on the snout capable of

inflicting severe damage on nets. I lately saw a number cruising around the Sea of Marmora and neighbouring waters, their great sail-like fin showing above the surface for miles. Several were taken in the local "Talian" nets during my stay in the Gulf of Ismidt, so that I had many opportunities of handling them. Then there is the Sturgeon, a bearded dweller in Russian rivers, which occasionally wanders as far as the coasts of Britain. The great Tunnies and Bonitoes, which look like magnified Mackerel, are also among our rare visitors.

The curious Angler-fish is a native, taken only as a rule in the trawl, though now and again on the hook. It has a little fishing rod on the top of its head, and with this it angles in the dark caverns under the sea, attracting little fishes with the silvery bait and then swallowing them in its enormous mouth. It preys not only on fish, but also on diving birds, and both Cormorants and Razorbills have been found in its stomach. A Cormorant, swallowed whole, should be a dish for an epicure!

Now and again the fishermen tell one of curiously shaped fishes in a particular district. As a case in point, mention may be made of the short-nosed Seabream familiar round Plymouth, which look as if they have lost the upper jaw. As a matter of fact, they have, and the explanation lies in the fact that when they are very young, and known as "Chad," they so worry the hooks with which the fishermen are trying to catch something bigger that the men continually jerk the lines, thus tearing away the upper jaw of any fish too small to get itself properly hooked. The fish thrives in spite of this deprivation, and in time quite a number of large deformed Bream find their way to the Barbican, which is the Plymouth fish market.



From a photograph by Leonard Step, F.L.S.

JOHN DORY.

Not only do different fishes vary very much in size, but the same fish shows differences in waters far apart. When I say "the same fish," it is perhaps more correct to regard these as different "races," which means that, while they are not sufficiently unlike to make them two separate "species," the difference in size constitutes a distinct race. When, many years ago, I lived on the shores of the Baltic, I noticed that the Herrings were much smaller than those of our east coast, but I did not then know that they never grow any larger. In like manner, the Mackerel of the Mediterranean are also much smaller than our own. Here, again, it is a matter of race, for in the teeming waters round Constantinople there are millions of tiny Mackerel, known as "*Ciri*," which the native fishermen catch in tons; and there are also enormous Mackerel, which, every few years, bank in such enormous masses that it is computed that no fewer than a million are taken every night for a month. The Plaice is another fish which shows a wide range in size, and the Baltic also has a small kind of Plaice which never grows any bigger. Possibly, the small size is a question of a shortage of food.

F. G. AFLALO.

THE GREATER WHITETHROAT AND YELLOW-HAMMER

By BENJAMIN HANLEY

With Photographs by the Author

THE Whitethroat, an excitable little brown bird, is one of the commonest of our warblers, and is to be found by almost every wayside during the summer months, for, like other warblers, it is a migrant, spending the winter months in Southern Africa, arriving here toward the middle or end of April and leaving early in September.

It is an interesting little bird, and not the least noticeable trait is its habit of dancing or fluttering along the top of a hedge or bush with head feathers raised in the form of a crest and throat puffed out, often flying into the air a little way to sing a pretty but short song, and then, as suddenly, dropping again.

For nesting sites, a nettle bed, wild

NEST AND YOUNG OF WHITETHROAT.

NEST OF YELLOW-HAMMER.

rose or bramble bush, and tangled vegetation by the hedgeside may be chosen.

The nest is a very frail structure made of hay and fine dead stems, lined with horsehair. The eggs, five or six, are greenish white with close ash-grey mottling—sometimes thicker at the larger end.

This bird is an insect feeder, but it also partakes of a little fruit if such can be had. It has a rather harsh alarm note, and a scolding one, which often leads to its being mistaken for the Sedge Warbler. Two well-known local names are "Peggy Whitethroat," or even "Peggy," and "Nettle-creeper," the latter from the bird's habit of frequenting nettle beds.

One of the most conspicuous of our wayside birds is the Yellow - Hammer, with his bright yellow head and breast; and although no songster of high degree, he is a great favourite with many, and I think all will agree that the countryside would feel the loss of his song, which may be heard constantly during the hot summer days when other birds are mostly silent. It is a rather plaintive song, inclined to be monotonous, often likened to the words "A little bit of bread and no cheese," the "no" being emphasized and the "cheese" long drawn out.

Only the male has the bright yellow colouring; the female is streaky brown with just a trace of yellow on head and breast. It is usually a late nesting bird. I have often found the nest in August, and I once saw one with eggs built in the side of a newly made barley stack in September. The nest is usually placed on the ground, or near it—a hedge bank being a favourite situation.

YELLOW-HAMMER (FEMALE).

SUNLIT MEADOWS.

From the Oil Painting by Algernon Talmage, R.B.A.

YOUNG BLACK-HEADED GULL SWIMMING.
About five weeks old

THE BLACK-HEADED GULL

"All day long their nesting haunt is a scene of animated life"

By BENJAMIN HANLEY

With Photographs by the Author

ACRES and acres of heather, stretching as far as eye can follow, broken here and there with great whin bushes ablaze with gold, silver birch, mountain ash, or dark spruce fir. Along the horizon stretch dark pine woods beloved of the wood pigeon, and just in front long, narrow streaks of silver tell of marsh and fen or boggy pool, the haunt of the waterfowl—wild duck, coot, moorhen, or little grebe—and here, too, nests the Black-headed Gull (*Larus ridibundus*).

As one approaches, a vast flock of Gulls, thousands in number, arise from their nests amid the reeds and sedges fringing the pools. Higher and higher they rise, presently to wheel and turn in all directions, all the while creating a clamour well-nigh deafening. The Gulls arrive at these inland nesting haunts in considerable numbers about the third week in March, and the eggs may be found about the second week in April and until the end of June.

The nest, built up of aquatic grasses, is placed amongst the reeds fringing the pools. In some cases scarcely a handful of material is used, on odd occasions

nothing at all; and at others it is quite an elaborate structure, dead sticks and twigs, sprays of heather and furze being utilised as well as grasses. Much depends upon the situation chosen. If the reeds are thick, little nest is required to keep the eggs clear of the water; but in others a quantity may be necessary. I have found the nests placed on the ground at some distance from the water. The birds nest in close proximity, the small reedy islets dotted about the ponds being the most used. On one such islet only about eight feet in length and four feet in width, I saw no fewer than twenty-one nests this season. The eggs, two to three in number, are subject to great variation not only in regard to colour, but also size and shape. Some are pear-shaped, like the plover's; others rounded like a pigeon's. The average size is two inches by one and five-eighths. The ground colour may be anything from pale bluish green to amber brown, spotted and blotched with dark grey and blackish brown. In some cases the markings form a distinct ring round the larger end, and in others are quite evenly distributed. On odd occasions pale blue eggs without any markings may be found, and I have seen a clutch the same ground colour covered with fine light brown spots. One of the three eggs is generally different from the remaining two.

Sometimes four eggs may be discovered in a nest, but this is not at all usual, and generally is the result of two birds laying in the nest. However, they have been found where the close similarity of the four eggs left no doubt that they were the product of one bird.

The young are clothed in a down of yellowish buff and brown, and take to the water when quite young. Their first feathers begin to appear when about three weeks old, but the youngsters are unable to fly until about a month later. When fledged their plumage contains a good deal of brown, but not so much as in the case of the young of other Gulls. It is interesting to note that the Gulls endeavour to knock their young into the water during their first attempts at flight, doubtless because of their thinking the young birds are at such times scarcely strong enough to undertake aerial navigation successfully.

With strangers the birds are very shy,

YOUNG BLACK-HEADED GULLS.

BLACK-HEADED GULLS AT NESTS.

BLACK-HEADED GULL ABOUT SIX WEEKS OLD.

NESTS OF BLACK-HEADED GULLS.

and rise off the nest when one is a hundred yards away, but in time they become fairly tame. This season I spent a week amongst them, and after the first two days I was able to approach within twelve feet of the sitting birds without alarming them, and if they were disturbed from any cause they returned to their duties without hesitation. Often two birds would claim the same nest; this resulted in a short, sharp fight, the loser flying aimlessly up and down just as if it were quite unable to find its own nest; indeed, such apparently was the case on the face of things.

Throughout the country there are many well known gulleries, the largest being at Scoulton Mere, where the birds have nested in thousands for upwards of three hundred years. Some, however, are of comparatively recent formation, this being so in the case of that where the accompanying illustrations were secured. In 1899 only six pairs nested in this locality, the following year twelve pairs, and again in 1901 only six pairs, but since that date they have been rigorously protected, and the rate at which they have increased is hardly credible, this season the number of nests being considerably over one thousand. Although gregarious as a rule, solitary pairs are not infrequently met with amongst the hills and tarns.

From the beginning of July the birds commence to leave their nesting haunts for the coast, and by the end of the month the breeding grounds present a deserted appearance save for the presence of less noisy waterfowl.

The name of "Black-headed" Gull is scarcely appropriate, inasmuch as it would lead one unacquainted with the bird to get a wrong impression of the colour of its head, which is not black, but during the breeding season dark chocolate brown, with a distinct white ring round the eyes. The rest of the year the head is nearly white, for as summer advances the white ring round the eyes gradually extends until it spreads completely over the head with the exception of a small patch over the ears.

In the case of some birds, however, this brown colouring appears to remain throughout the year; and, on the other hand, cases have been known where the bird, having put off this dark hood, has

FINDING A BLACK-HEADED GULL'S NEST.

never regained it. These cases would tend to strengthen the theory that the bird does not moult at these times, somehow the feathers merely undergoing a change of colour.

The bill and legs in the adult are bright red, and these, with the brown hood, contrast strangely with the snowy white and pearly grey plumage. It is when following the plough they are seen to advantage, the freshly turned-up brown soil forming an ideal background for showing up the delicate shades of grey.

The agriculturist is beginning to recognise in this bird a useful ally, whereas formerly, under the name of "seacrow," they were shot when opportunity offered, for it almost rivals the rook in devouring innumerable wireworms and other noxious grubs. Sad to say, this is not universally recognised, as is proved by the fact that during the nesting season numbers are picked up dead on the nest or in the water near by, having been shot whilst away and reached home only to die.

Although protected whilst at their nesting haunts from the attacks of man, they are not immune from the ravages of other foes. Numbers of eggs are sucked and young killed and partly eaten by brown rats—not water-voles—which, contrary to what one would think, enter the water and swim to the nests for that purpose.

When in flight the Black-headed Gull may be recognised, apart from its smaller size, by the conspicuous white edge along the front of the wings.

The usual note of this Gull is a harsh "Kak, kak," but when excited or alarmed this becomes a loud scream. All day long their nesting haunt is a scene of animated life, and the noise created is indescribable. As nightfall draws on the birds which have been away foraging in the fields one by one return to the gullery, each fresh arrival being greeted with renewed clamour. At length, as dusk falls, and even the very last stragglers are safely home, they settle down for the night; then, in contrast to the discordant screaming of the day, a stillness, almost eerie in its intensity, reigns unbroken, save for the peewit's plaintive cry or moorhen's croak. And so they rest until the eastern sky gives promise of another day's awakening.

YOUNG BLACK-HEADED GULLS IN NEST.

HOW TO KNOW THE SHRUBS GROWING IN BRITAIN—III

With Notes, descriptive and photographic, for their Identification in all Seasons of the Year

By HENRY IRVING

THE DOGWOOD THE PRIVET THE BOX

THE DOGWOOD

SPITE of the name, and notwithstanding its associated traditions, this shrub has nothing to do with the dog. Its original designation seems to have been Dagwood, the wood out of which "dags"—any loose ends of wood for special purpose—were made. A similar name, formerly current, was Gadrise, meaning the shrub from which "gads" or goads were taken. It is easy to understand that in the simpler times, when the countryman's instruments were for the most part home-made, being cut as required from the living wood, this shrub, as others, was named rather from the use to which it could be put than from any distinctive peculiarity of growth. Hence it is that these familiar names are of small service in the matter of identification.

The most distinctive characteristic of this shrub is the brilliant blood-red colouring of its twigs, particularly in late winter and early spring. Again, in autumn, colour becomes a distinguishing feature. No British tree or shrub can compare, for exuberance and richness of varied hue, with the crimson, orange, rosy red and purple, separate or combined, of the Dogwood's fading foliage. Abundant in the south of England, and particularly in the chalk districts of the south-east, it is of much rarer occurrence elsewhere.

DOGWOOD FLOWERS.

The straightly ascending main stems give it a somewhat erect habit of growth. The buds are slender and are pressed up against the twigs, being arranged in opposite pairs. They are protected by scales and are velvety to the touch, as also are the twigs. The leaves are a broad oval terminating in a point. The

DOGWOOD FRUIT.

margins are without teeth. The venation, similar to that of the Common Buckthorn, shows three pairs of strong secondary ribs branching from the lower half only of the midrib, and sweeping in graceful parallel curves towards the terminal point.

The flowers are gathered into dense stalked clusters at the ends of the shoots. The creamy-white colour and rounded shape of these flower clusters should distinguish them at once from those of the Privet, with which they are liable to be confounded, especially when seen in the hedgerow. Each flower is complete, having four narrow, creamy petals, four yellow-headed stamens, and a pistil. Nectar is exposed and attracts numerous insects, mostly flies. The fruit is globular, bluish-black in colour, bunched at the end of a single branching stalk. Each is a stone fruit with double seed chamber.

DOGWOOD LEAVES.

THE PRIVET

This, as a wild plant, has practically the same range as the Dogwood, being found chiefly in the chalk and limestone districts of the south. Its partially evergreen character, its multiple branching, and its adaptability under the shears, rendering it pre-eminently suitable for the garden hedge, have occasioned its almost universal planting for that purpose.

The minute buds are protected by about four flattened scales of a purplish-green colour. The leaves, in opposite pairs, are oblong, tapering to a point at either end. The stalks are short. The texture of the blade is smooth and firm, but it lacks the hard leatheriness so characteristic of the true evergreen. A few weak and sinuous secondaries branch off from the main rib, but these are scarcely discernible. Except in very severe winters the leaves, which may become a deep bronze in colour, remain attached till the new buds commence their growth in spring.

The flowers, gathered into pyramidal clusters at the ends of the shoots, are a clear white. Each has four petals forming a short tube with turned-back lips, very like the flower of the lilac, but smaller. Each is complete with stamens and pistil. Bees, butterflies,

FRUIT CAPSULES OF BOX

flies. and beetles are assiduous visitors. The fruit is globular — a shining black "berry" enclosing in its purple pulp a single two-celled stone. If bullfinches are anywhere in the neighbourhood they will be sure to visit a Privet hedge some time in the course of the winter, searching for the fruit.

THE BOX

Really a shrub. the Box makes some small pretence to being a tree, though not with any conspicuous success. as in the woodland undergrowth on Box Hill in Surrey. Their lanky stems, generally several in a group, straggling into and among the overgrowing Yew or Beech, give the impression of "legginess," as a gardener would describe it, rather than of a sustained standard growth. Many of these reaching a height of fifteen or twenty feet, with a greatest diameter of about six inches, densely branched and foliaged, but with little of defined shape in the crown, serve mainly to deepen the shade in which they live and seem to thrive. Out in the open, with light reaching them on every side, they form by preference dense rounded clumps, stems and branches completely hidden by the close-set evergreen foliage.

The bark is yellowish and smooth with a tendency to scaliness. The buds are scarcely discernible. The twigs are four-angled. The leaves, under an inch in length, are oval, not pointed but frequently notched at the apex. They are polished above, of a deep full green, matt beneath and paler. In texture they are hard and leathery. The secondaries, branching from the midrib, are straight and parallel, but obscure. The series of

FRUIT OF PRIVET

LEAVES OF BOX.

small shrubby plants—whortleberry, cranberry, etc.—have very similar leaves, but with these plants the leaf arrangement is alternate, whilst that of the Box is opposite.

The flowers cluster at the base of the leaves and seem to encircle the twig. They are of two kinds, though found in a single cluster. Centrally is a three-angled pillar-like body having three projecting parts at the top. This is the fruiting flower and matures first. A little later this is beset at its base by what seems a crowd of yellow stamens. A closer scrutiny will show that these are grouped in fours, each set rising out of a tiny saucer-like receptacle, which with the stamens constitute the pollen-bearing flower. There are no petals. These flowers are visited by bees for the sake of the pollen, but this probably has little effect in the matter of fertilisation, which is almost, if not entirely, dependent upon the wind. Lord Avebury states that since the pollen, "like that of wind flowers generally, is dry and dusty, the hive bee moistens it with nectar from its mouth and then brushes it on to its hind legs."

The fruit is an erect three-celled capsule with three projecting points at the top. Each cell contains two black seeds. When ripe the cell splits open lengthways, exposing the pair of seeds partially enclosed in an inner chaffy chamber. The walls of this inner chamber contracting, pinch the seeds till, slipping free, they are ejected to a considerable distance. These seeds germinate freely, and multitudes of seedlings spring up in the vacant spaces, maintaining a woodland undergrowth in those spots, as on the summit and slope of the chalk down, where the Box thrives in association with the Beech and the Yew.

HENRY IRVING.

FLOWERS OF BOX.

FERNS

Spore arrangement

Spore enlarged

First growth

Fronds.

Hart's tongue.

PLANT LIFE

FERNS

Specimens required :—COMPLETE PLANT OF COMMON FERN

Structure

1. *Roots and Rhizome.*—Examine the underground portion of plant, noting the true roots and the underground stem—*viz.* the rhizome.
2. *Stem and Fronds.*—The stems bear fronds. Note mode of growth of young fronds.
3. *Fronds and Spores.*—Select a well-developed frond and examine underside. Regularly arranged clusters are observed. Examine under lens and note shape of clusters. These are the spores by which new plants are produced.

Reproduction by Spores

Prepare a shallow box filled with a mixture of rich loam, leaf mould, and sand. Smooth the surface and scatter ripened spores over it. Keep moist and cover with glass plate. Note the development of small fern plants.

Note.—If the spores be placed on a porous plate and kept moist the development of the *prothallus* (or flat growth) may be observed.

SENSITIVE PLANT AFTER CONTACT.

CHAPTERS IN PLANT LIFE

VII—THE FEELINGS OF PLANTS

By S. LEONARD BASTIN

With Photographs by the Author

QUITE a short while ago the vegetable world was considered to be something very distinct from the animal kingdom. The difference between the two living creations appeared to be so sharply defined that the idea of any connection seemed to be entirely out of the question; at any rate, such was the view of the matter to those who were content to take a mere external survey. It is now, of course, well known that in the primal forms of existence plant and animal so closely resemble one another that the keenest investigation fails to establish any line of demarcation. Indeed, the same basis is responsible for the manifestation of life equally in the vegetable and the animal. In the green chlorophyllian tissue of the plant can be recognised the wonderful protoplasm, no less than in the specialised nervous system of the animal. This being so, it is a matter of great interest to consider the response of the living matter in the vegetable to external stimuli, and thus find further evidence of the

intimate relations between all living things.

In the old days it was often suggested that plants cannot feel, although on what grounds the assertion was made it is not easy to see. Reduced to its simplest possible form, the ability to feel merely indicates the power of response to a stimulus. The pupil of the human eye is so delicately adjusted that it can feel the influence of light, contracting when an increase in the amount of illumination takes place, and expanding when the light-rays are few in number. It is easy to prove that a plant can feel the light. Place a healthy specimen in front of a window in such a position that the light can only reach it from one direction. In a few days the growth of the plant is entirely altered; its upright bearing goes, and it leans over so that the upper surface of its foliage may be fully exposed to the stimulating rays. The same point may be very strikingly illustrated if a small collection of seedlings is grown in a box with a single aperture, when it is seen that all the young stems turn towards the path of the light. Some little plants are astonishingly sensitive even to very feeble illumination.

Darwin showed that the cotyledons of Phalaris became "curved towards a distant lamp which emitted so little light that a pencil held vertically close to the plants did not cast any shadow which the eye could perceive on a white card." In another experiment it was shown that if seedlings kept in a dark place were laterally illuminated by a taper for a minute or two at intervals of three-quarters of an hour, the little stems leaned over to the direction from which the intermittent light had come. Normally the extreme sensitiveness of leaves to the action of light is well seen in the case of climbing plants, particularly when the specimens are growing up a wall. Even though the effort may entail considerable distortion of stalk, the leaves are invariably brought round so that the face

THE SENSITIVE PLANT.

THE TENDRILS OF THE VIRGINIAN CREEPER TURN AWAY FROM THE LIGHT.

of them is held outwards. It is easy to understand that it is to the advantage of most plants to bring their foliage into such a position that a maximum amount of light is secured. Movement towards the light is not an invariable feature in the organs above ground of all plants. In the case of the Ivy there is a distinct tendency for the shoots to bend away from the light.

More strange still is the behaviour of the tendrils of the Vine and Virginian Creeper. These processes always shun the brightly illuminated quarters, and seek out the dark parts. The phenomenon is all the more remarkable when it is remembered that in origin these tendrils are modified leaf-shoots—portions of the plant which in the ordinary way would certainly not turn away from the light. That the tendrils are more likely to obtain a hold by directing their growth to the dark cracks and crevices than if they grew out to the light, is, of course, obvious. A most curious instance in which the same part of a plant is affected by light in different ways at different times is to be seen in the case of the Ivy-leaved Toadflax (*Linaria cymbalaria*). The flower-stalks at first incline towards the light, but as soon as the blossoms have been fertilised the stems turn in an opposite direction and so bring the capsules into a position for planting the seeds in the crevices.

On occasions the foliage of the plant is seen to shun the light. It is noticed by all travellers that the Australian forests offer very little shade; this is simply due to the fact that certain of the trees (particularly the Eucalypti) hold their leaves edgeways to escape the fierce rays of the sun. It is curious that the seedling Eucalyptus trees bear their leaves laterally. Of course, these young specimens growing in the partial shade afforded by their parents are not likely to suffer harm from the sun's rays. The so-called Compass Plant (*Silphium*) has leaves which twist laterally when the sun shines upon them, and in this way avoid the injurious effects of too strong an illumination. Many plants under the influence of very strong sunlight droop their foliage; partly, of course, because of the excessive transpiration of moisture; but we may take it that the change in position is a useful protective measure.

As to the causes which underlie these light-seeking and light-avoiding movements, we cannot find any all-sufficing explanations. Certain it is that they only continue so long as the plant is in a growing state. We know that light has

a retarding influence on growth, and it has been suggested that plants lean towards the point of illumination, because the shady side of the stem extends more rapidly than the part which is strongly lighted. This theory does not help us to understand how it is that parts of the plant avoid the light. One cannot but feel that in all these phenomena there is something more than a mere mechanical adjustment, and that most of these responses must be the outcome of inherent tendencies which exist in the plant. Whilst a little observation destroys the illusion that the Sunflower always follows the sun, there is no doubt that the plant, in common with a large number of species, does move its blossoms towards the glowing orb. This is perhaps particularly noticeable in the case of composite plants.

VENUS FLY-TRAP, OPEN.

The Common Hawkweed, which grows so abundantly in our fields, leans its blossoms over very distinctly to the sun. Thus an observer standing with his back to the south sees the field as a blaze of gold, but turning in an opposite direction there is nothing to be noticed save the backs of the flowers. Much the same kind of thing is to be seen in many species of Anemone. On a brilliant day it is observed that the copse appears to be starred all over with the white flowers of the Wood Anemone, but with a slight change of position the flowers seem to disappear, simply because the blossoms are all fronting in one direction.

The Sensitive Plant is a species with many interesting points. This curiosity goes to sleep every night, but, of course, the most striking feature of the plant is its extreme sensitiveness to contact. As is so well known, the lightest touch is sufficient to make the leaflets close upon their support, the petiolules to draw up together, and the leaf-stalks to collapse. The most singular feature is that the shock may be communicated to other parts of the plant, and even, at times, to the whole specimen. The Sensitive Plant has something which is strangely like a rudimentary nervous system, in that it would seem that there is a continuity of susceptible matter throughout the whole specimen. There is little doubt that the contractile power resides in small cylindrical cushions—pulvini—which occur at the points of insertion of the leaf-stalk with the stem.

A pulvinus is a process containing a woody centre surrounded by spongy cells rich in water. Now, when one of the leaflets of the Sensitive Plant is touched, the effect is transmitted, probably by the threads of protoplasm passing through the cell wall, to the pulvinus.

The outcome of the reception of the shock is that the water passes from the cells on the lower side of the process to those in the upper part, and, as a consequence, the former portion becomes

flabby and is no longer able to support the leaf-stalk. Thus the organ falls by its own weight. After an interval the water in the cells regains its original distribution and the leaf assumes its normal position.

It is only during the period of active growth that the Sensitive Plant exhibits great susceptibility. Moreover, a high temperature seems to be an essential feature of a prompt response to touch on the part of the specimen. Up to a certain point the Sensitive Plant seems to be able to become accustomed to shock. A curious experiment was conducted many years ago in which a young specimen of the plant was placed in a carriage. Directly the vehicle started to move the plant drooped its leaves, but as the movement continued, the effects of the shock became less and less until something like a normal position was assumed.

Certain plants are curiously responsive to electrical influence. One of the most remarkable of these cases is that of the *Abrus precatorius*, an Indian leguminous plant. The behaviour of this species has given rise to a good deal of speculation from time to time, and it has been claimed that warnings of the approach of magnetic storms and electrical disturbances may be gathered by a close observation of the position of its leaflets. This is certainly crediting the plant with powers which it does not possess, although there is no doubt that the Abrus is responsive to the variations in illumination, temperature, etc. It is doubtful whether the plant is more sensitive in this way than the Mimosa. A young specimen, which the writer had in his possession, evinced considerable leaf agitation during the progress of a thunderstorm. Almost all these sensitive plants are very much affected when exposed to the vapours of an anæsthetic; in this instance the foliage assumes the position which it takes up at night.

The Telegraph Plant (*Desmodium gyrans*), has well been called one of the most curious in the world. Certainly it presents a problem which has completely baffled all scientists. The leaves of this species are divided into three parts, consisting of a large leaflet and two smaller lateral ones. It is these latter which offer a strange phenomenon, and one which is not at all easy to explain. Practically throughout the whole of their existence these leaflets are in motion, executing little jerks, which suggest the movements of the seconds hand of a watch. When one of the leaflets rises the other descends, each in its turn describing a kind of elliptical course.

VENUS FLY-TRAP. SHUT.

These movements occur throughout the life of the plant, although the greatest activity is evidenced by the leaflets during humid days when they are under the influence of bright sunshine. The duration of each movement varies from about

one and a half to three minutes, and if a leaflet should be restrained for a while, the rate of travelling is very much increased. Although it is nothing like so perceptible, the larger leaflets also change their position, moving first to the right, and then to the left, with a slow, continuous movement. The most singular point about the jerks of the leaflets of the Telegraph Plant is that they seem to occur quite spontaneously, and not in reponse to any external stimulus. The explanation of this strange phenomenon is still wanting, neither is it easy to see that the plant derives any benefit from its remarkable habit. Specimens of the Telegraph Plant are to be seen in most botanical gardens.

Among the insectivorous plants there are to be found some striking instances of plant sensation; indeed, certain of the species are very highly specialised in this direction. The Droseras, or Sundews, are well-known little plants found in various parts of the world, the genus being represented in Great Britain by three examples. The Round-leaved Sundew (*D. rotundifolia*) is found commonly in boggy places. The plant, although small, is rendered somewhat conspicuous on account of its rosettes of bright-red leaves. It is worth while to examine the foliage rather closely. The leaves are seen to be covered with clubbed hairs, at the ends of which are produced sticky glands.

It is strange that the foliage of the Sundew seems to have a peculiar fascination for flies and other insects, albeit that these little creatures as a rule, pay a heavy penalty for their curiosity. So sensitive are the hairs on the Sundew leaf that the struggles of a fly held by the sticky secretion induce the processes to close round the unfortunate victim, so that escape is quite out of the question. At the same time these movements are accompanied by an excretion of a digestive fluid which aids the leaf to assimilate the nitrogenous matter in the body of the fly. Another curious feature in the behaviour of the tentacles of the Sundew leaf is that they entirely fail to respond in any way to drops of water which are allowed to fall on the foliage. As well, too, it is remarkable to note that although small stones may be enclosed by the tentacles, yet in these instances there is no discharge of the digestive fluid.

Even more remarkable than the Sundew is the Venus Fly-trap (*Dionæa muscipula*), a little plant which is a native of the swamps of North Carolina. The leaves of this plant, which mostly lie out flat on the soil, are composed of two very distinct parts, a stalk and a blade. The stalk, a leafy expansion which really performs the functions of ordinary foliage, is joined to the blade by a narrow neck. The blade is formed of two plates which are united by a rib fashioned somewhat on the lines of a hinge. The outer edges of the plates are furnished with borderings of rough bristle-like hairs. The sensitive part of this little trap exists in three cilia arranged in triangular fashion on each half of the blade. To touch one of these ever so lightly is to induce a rapid closing of the little apparatus; the plates snap up together, the fringe of hairs interlocks—the whole proceeding strongly suggesting the shutting of a very perfectly contrived trap.

Now, if the object which comes into contact with one of the sensitive hairs should happen to be a fly, the result is, of course, disastrous for the unfortunate insect; no escape is possible for the victim, whose body will be retained by the Dionæa leaf until the desired nutrient properties have been absorbed. In order to attract the flies, it appears that the upper surfaces of the plates are furnished with certain small glands which secrete a viscous fluid peculiarly alluring to insects. It is singular that no other part of the leaf of the Venus Fly-trap is at all responsive to contact. The back of the organ, even the surface of the plates themselves, may be touched; but unless one of the bristles is jarred the little trap remains immovably open. Experiment with this strange plant showed that whilst the blades would enclose small pieces of stone, for instance, yet these would not be retained for any length of time. A short while after acceptance, the blades will slowly open and permit the unwanted substance to roll away.

There is no doubt that there is a great deal in the behaviour of roots which it is

not at all easy to explain. Indeed, Darwin has gone so far as to say that the tip of the radicle, in its power of directing the movements of adjoining parts, acts like the brains of some of the lower animals. Much that the growing roots accomplish, however, is the outcome of simple circumstance. We are no longer puzzled, as were the old botanists, by the manner in which roots will seek the damp portions of the soil. The additions to growing roots will take place along the line of least resistance; this will naturally be through the soil which has been loosened by water. In this way the roots will ultimately arrive at the source of the moisture.

LITTLE FERN SENDING DOWN ROOT ON OUTSIDE OF POT TO WATER.

Other problems presented by roots are not nearly so simple, and lead one to the conclusion that these organs may be able to feel at a distance. The roots of trees will not infrequently force their way in between the brickwork of wells some distance above the water level, finally spreading out downwards until their growing points are completely immersed. A little fern, which the writer had in his possession, was most interesting in this connection. The plant was growing in a pot which always stood in a saucer of water. It would seem that the supply of water was not sufficient for the needs of the specimen. On this account the plant actually sent down a root on the *outside* of the pot to the water in the saucer beneath. It is sometimes noticed that the roots of tropical Aroids, such as the Monsteras, when grown under glass, are very clever in directing the growth of their roots towards water tanks which may be beneath them.

A very singular case of root perception, and one which it is interesting to recall, is recorded by Carpenter. He tells us that in a hollow in the upper part of an old oak, the seed of a Wild Service Tree was accidentally sown. After the germination of the seed the little plant grew for a while in the decayed vegetable mould collected in the opening. As the young tree increased in size, however, the need for more room made itself felt, and accordingly an attempt was made to reach the ground. The roots were sent down inside the stem of the tree, which was hollow. In the soil to which they directed their growth there was a large stone—about a foot square. If the direction of growth had remained unchanged, the roots would have simply come right down on to the stone. Strangely enough, about half a yard above the stone, the roots divided into two parts; thus when reaching the ground the soil was penetrated on either side of the obstruction. It is not at all an easy matter to offer an explanation of a phenomenon of this nature, which in slightly different form is not an infrequent occurrence in some of our older forests.

S. LEONARD BASTIN.

AN EXCEPTIONALLY STRONG SWARM WEIGHING 11 lbs.—55,000 BEES.

WOODLAND STORIES

THE QUEEN'S FLIGHT

By S. L. BENSUSAN

With Photographs by G. E. Green

CONSCIOUSNESS had hardly been hers in the five days that were passed. In the form of a grub such little recognition of outside influences as came her way was no more than the pleasant sense of wants supplied. She was in a cell depending solitary from the edge of the comb, larger than the ordinary cells and shaped roughly like an acorn. Into the mouth of this cell in those brief days of consciousness the nurse bees were busy emptying a rich store of bee milk made up of pollen and honey, that they themselves had digested before they gave it up to their nursling. There was more than the young grub could receive; it overflowed into the cell where she was spinning the silken shroud that was to wrap her for more than a fortnight's sleep. The nurse bees sealed down the mouth of her cell, but there was a generous allowance of space and air, and in those blind depths, which no human eye can picture, the Queen Bee grew and woke to a sense of anger and excitement that expressed itself in a shrill cry.

"Let me out," she shrilled, "I am a Queen Bee, and there are others in this hive. Let me go that I may do battle with them." All round her the guard was stationed, she remained a prisoner. But far above her, in a corner of the hive, came an answer to her challenge, the

cry of the Old Queen bee, her mother. "I have kept my sword for you and for all your sisters," cried the Mother Queen; "there shall be but one mother in this hive." Then there was a sound of scuffling and remonstrance, a shrill cry of rage repeated over and over again; while a sense of excitement and turmoil seemed to pass almost physically over the hive, communicating itself to the worker bees as they came in laden with pollen and nectar and to the drones as they lumbered clumsily home from the fields, careless of everything save abundance of sweets and long hours of rest. Then the outcry died away, the Old Queen had been appeased.

Of food the Young Queen found plenty, but her liberty was yet to come, for as soon as one of her guards went off duty another came to take his place; and, at times, the Old Queen could be heard making a fresh effort to break through the living wall round her and work a savage will upon her helpless children. From three other parts of the hive the challenge of the queens was answered. The workers had made four queen cells, taking eggs to them from the worker cells. In each a bee, equipped to become a mother of more than 250,000 children, was calling for liberty and battle. Towards noon on the following day, after long hours of extraordinary turmoil, followed by a few minutes of complete silence, there was a rush as of many thousands leaving the hive. It was altogether different from the noise made by the few hundred drones

THIS FRAME HAS A FOUL BROOD.
Notice the irregular cappings and the Queen on honey-cells.

TRANSFERRING BEES FROM ONE HIVE TO ANOTHER.

at midday. The Old Queen had swarmed and gone her way; the guard about the Young Queen's cell was removed, and she was at liberty to move about the hive.

Three days later, after one or two preliminary journeys into the air, she had taken nuptial flight and had returned safe and sound to the hive, bearing with her the trophies of brief converse with a drone that had died in the hour of his victory. She rested awhile from her labours, and then for one day she had laboured over the brood cells, guarded and groomed and fed and flattered by the worker bees who had congregated round the cell in which she was born. Then the cry of three of her imprisoned sisters, challenging her supremacy, roused her to ungovernable wrath, and this time the workers did not attempt to stand between her and her anger. Sight and smell and hearing all served to direct her to the queens' cells where her imprisoned sisters were still confined in fashion that left the lower part of their bodies exposed. The long sharp sword that was part of her equipment she had used with deadly effect upon the hapless prisoners; there could be but one Queen. The worker bees dragged out each murdered body from its cell and passed it over to the undertakers of the hive, who bore their burdens as best they could to the ditch that was the common burial ground. A few of the workers round each queen cell greedily devoured what remained there of the bee milk; then the cell was

scoured and nothing was left save the cocoon to tell of the tragedy that had been enacted.

Thereafter her rule had not been disputed, though it was directed by the worker bees, who had led her in regular order over the cells, determining for themselves what eggs she should lay and of what kind, conscious of their ability to increase or limit the number of drones, and raise more queens if they should wish to do so, by isolating a worker cell and feeding the new-born grub with the richest food in most generous fashion.

A year had passed since then. Another summer was at its brightest, and countless fields of flowers offered their nectar to the bees. The hive was full and prosperous, but the Queen Bee knew that a crisis in her life had come. Quite unbeknown to her the workers had prepared queen cells; the first signs of life were audible there, and she knew that the hour was approaching when she must face rivals, and possibly meet her death. Friends she had none, for in the hive friendship is unknown, duty has taken its place. Very bitterly she had rebuked her courtiers—the workers who had fed her with the richest food as long as it was necessary for her to lay eggs, but had left her when the cold weather came to fare on simple honey along with the rest. She had begged and threatened, but all to no purpose; just as she had been cared for in the early days, so the young queen bees were being cared for now, and at last, in an agony of rage and resentment, she had cried, "To-morrow I will leave the hive, and all who care may follow me."

In a few moments this threat had penetrated every corner of the citadel, stirring even the lazy drones to consciousness of some other interest in life than food or play. The various committees that direct the operations of the hive, supervising the labours of the bees that work the air supply, the sentries, the nurses, the wax makers, the builders, the undertakers, the scavengers, and the drones, held excited and noisy councils. In place of the regular subdued murmur of the hive that told of the even tenor of work, there were countless jarring sounds in different keys and of varying intensity. Among the laws of the hive—known to every worker—was the one that said, "A Queen Bee may swarm if she care to, while if it be the will of the community to supersede her, and she does not swarm, she may be put to death." Very quickly the vast numbers gave their decision and divided themselves up. More than twenty thousand decided to swarm, while the rest elected to remain where they were and appoint the strongest of the young queens to take the Old Queen's place. All through the night various plans were discussed. Only the fanners, upon whose labours the air of the hive depended, remained constant to their task, while with the break of day those who had decided to follow the Old Queen to exile sent scouts out, north, south, east and west, to look for a new home.

After deciding where the swarm would light, the Queen Bee waited anxiously for midday. The cries of the imprisoned queens in their guarded cells awoke in her, every now and again, short, sharp fits of frenzy, but for the restraining guards she would have put the need for swarming beyond further discussion. A spirit of unrest ruled the hive, from the honey cells at the top to the brood cells below and to the alighting board, beyond which the bees responsible for the air current still laboured as though they alone were unaffected by the coming change. Whatever happened the current of pure air must flow through the hive, and so they fluttered their tireless wings while their fellow workers inside the hive, save the few who were generating a contrary draught, seemed to have forgotten the call to the fields and all the wealth that awaited their gardening. The morning waxed bright and glorious, the song of birds and insects penetrated to the heart of the hive, summer called the workers to the field, but for once her summons was ignored by the most of those it reached.

"Prepare yourselves," cried the Old Queen at last, "it is time to go." Scarcely had this signal been given when the clamour died down as though some spirit of peace had descended upon the population. During the next few minutes every bee that had arranged to follow the Queen filled herself with as much of the hive's store as she could carry.

SHAKING THE SWARM INTO A SKEP.

None knew where or when the next meal would be taken or what fortune would follow departure from home. Yet, again, the Old Queen called. "Forward," she cried; and with a mighty rush some thousands of workers left the hive and circled in the air with a great noise of wings and many shrill cries of excitement, pitched too high for any human ear. Seeing her huge cohort leading the way, the Queen moved steadily to the alighting board, stretched her wings that had been unused for so long, and rose into the sunny air, followed almost immediately by her retainers, who had not left her for a moment.

Behind her came the rest of the swarm, and soon these many thousands of sober workers were playing in the sunlight as though they had never known the meaning of toil. They moved in large sweeping flight, much greater than that which served them when they came to and from the fields; and as they went round they sang their own shrill summer song as though they knew that this was for them the one holiday of their life, and that when it was at an end there would be no further respite from labour until work was ended for all time.

At the far end of the orchard a young mulberry tree had allowed one branch to stretch out beyond all the others, and the gardener had allowed it to remain for reasons best known to himself. Hither the Old Queen made her way; the dense swarm moving in large circles round and round her at a pace that made the air as full of sound as sunshine. Gradually the flight of the bees took a circular shape, a living wheel seemed to go round the tree, very large at first, but contracting gradually until in a few moments it had disappeared, and in its place there was one long cluster of bees hanging down in some mysterious fashion from the branch of the mulberry tree itself. The ardour of the swarm had proved of short duration. Once again

intelligence had taken the place of emotion; the original problems of life had taken their place in the bees' consciousness. Now they hung round their beloved Queen almost motionless, waiting upon events. Gradually the scouts, absent since early morning, might have been seen following their aerial roads to where the swarm was stationed, and they shrilled the news of their traffic and discoveries in fashion that communicated the intelligence to the stationary swarm.

From the flower garden where he was at work, the old gardener had seen the exodus and, greatly pleased to see the truants had settled within reach, was moving in leisurely fashion to find a skep in which to hold it. But the skep was right at the back of the toolhouse, and the gardener was no longer active. Many odds and ends had been piled upon the skep, much dust had accumulated in its crevices, and so he took a brush and, in most leisurely fashion, cleaned it and then went to the herb garden to gather a few leaves of thyme and other herbs with which to freshen and sweeten it, for it was the old man's theory that even a skep should be made attractive and pleasant to the bees. His work completed, he moved at last in the direction of the mulberry tree. But before he could get within thirty yards of it there was a sudden commotion, the outer circle of bees began to fall off and fly round. The circle enlarged again rapidly; the whole swarm was on the wing, and a moment later was heading off across the valley, leaving the gardener to sit down upon a wheelbarrow and wonder audibly.

There was no occasion for surprise. While the bees were in their cluster under the mulberry shade, the last of the Old Queen's scouts had come bringing news of a hive, clean, sweet scented and empty, in a garden across the valley. She shrilled her tidings of flowers full of fragrance, of a wealth of pollen and nectar inexhaustible, and told how beyond the garden there was a field full of ripening white clover. Such a prospect removed all need for further consideration. Perhaps some shrewd but unscrupulous beekeeper, knowing that swarming time had come, had made his own preparations for it; and now the swarm was across the river and over the plantation that intervened between their old home and the new.

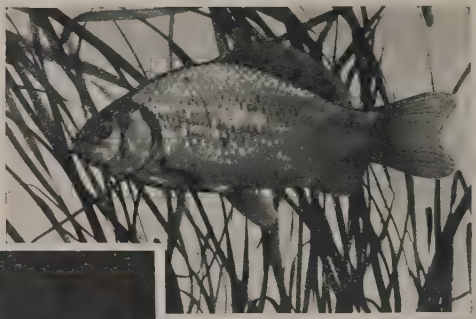
HOW TO KNOW THE COMMONER POND AND RIVER FISH

By STANLEY C. JOHNSON, M.A.

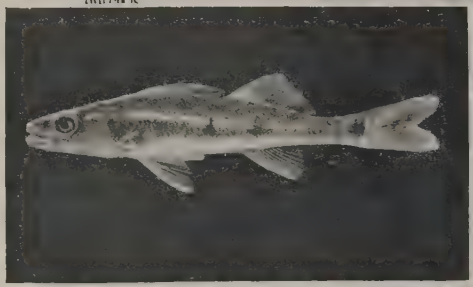
With Photographs by STANLEY and WALFORD JOHNSON

IN differentiating between the various fresh-water fish that commonly inhabit Britain, most confusion is likely to arise with the members of the Carp family. The typical representative of this group is the Common Carp, a fish that was extensively cultivated by the monks of the Middle Ages as an article of diet, and is now largely eaten on the Continent, especially in Germany. It is best recognised by the muzzle, which is blunt, rather small, with hanging barbels. In colour it is a rich greyish-brown. Two interesting varieties of this species are the Mirror Carp and the Leather Carp. The former has shining scales some four times the normal size, which are arranged usually in three rows running from head to tail; the latter is almost devoid of scales, its unprotected skin being the only covering.

A better-known member of this family



PRUSSIAN CARP.



PIKE PERCH.

TENCH.

RAINBOW TROUT.

is the Prussian Carp, a fish which may be distinguished readily from the Common variety by it possessing no barbels and being of a richer and less greyish-brown. The Prussian Carp inhabits still, muddy waters, burrowing in the bottoms of the ponds or rivers for vegetation and smaller animal life. It is extremely hardy and often lives to a considerable age. The Goldfish, with which we are all acquainted, is merely a coloured variation of this species.

ROACH (HAS RED EYES AND FINS).

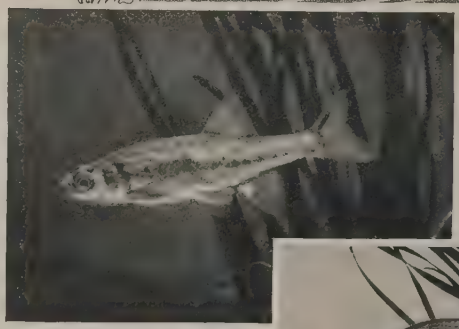
Four very confusing fish are Roach, Dace, Rudd and Chub, being similar in build and almost identical in habits. The Roach is the thickest set of this silvery quartet, having red eyes and, when matured, reddish fins. The Dace is of a longer and thinner type, and may be distinguished readily from the Roach in that its eye is not red. The Chub is very much like the Dace, but the anal fin in the former is convex, whilst in the latter it is clearly concave. The position of the dorsal fin enables us to differentiate between the Rudd and the equally broadly built Roach. With the Rudd this fin is situated midway over the anal and ventral fins, but just above the ventral fin in the Roach. All these fish prefer clear running streams, where they may be found swimming peacefully together in large shoals.

GUDGEON.

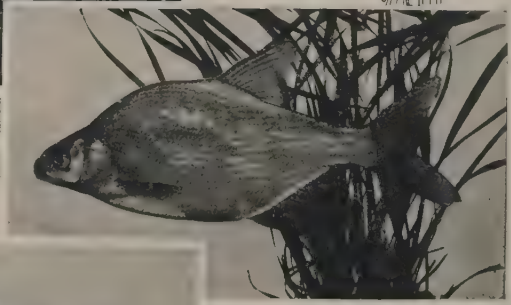
The Tench claims some relation to the Carp family. A somewhat heavy fish, it is slightly lethargic in its habits, preferring to lie hidden in the muddy bottoms of stagnant pools during the day and only venturing forth at night to secure its supply of insect and plant food. It is of an unmistakable olive-green colour, sometimes tinged with a blackish sheen. The fins have rounded edges and the scales

DACE (*LEUCISCUS VULGARIS*).

PIKE.
Note how the stripes help to confuse it with the weeds.



MINNOW.



SILVER BREAM.
Note unusual length of anal fin.

COMMON RUDD.

are unusually small. Like most of the Carp group, it can live for an extended period out of water if only it is wrapped loosely in a little wet moss or weeds. The Golden Tench is an acclimatised variety often met with in ornamental waters.

Of the Breams, there are two kinds ordinarily found in British rivers. The commoner species is the Silver Bream, a handsome bluish-white fish having a deep body with a comparatively small head and an unusually long anal fin. It is remarkably narrow in width, and on this account often goes by the name of Bream Flat. The second variety, the Pomeranian Bream, is thicker set, and has a yellow iris to the eye. It is usually considered to be a hybrid between the Continental Bronze Bream and the Roach. All Bream grow rapidly, and are of a hardy nature; they swim in shoals and feed largely on worms.

The Bleak is a silvery fish that may be recognised from the Dace by its long, almost Bream-like, anal fin. Its scales, we are told, were formerly used in making artificial pearls. It is a gregarious little fish, and is frequently found swimming in shoals at the surface of streams on the look-out for insect food.

Another variety distantly related to the Carp is the well-known Minnow. Having a large eye, a somewhat mackerel-like pattern on its scales and an incomplete lateral line, it should be easily recognised. It is not nearly so common now as it was a few years ago, as millions are annually netted for live bait.

Gudgeon also belong to the Carp family, having the barbels characteristic of the Tench and the Common Carp. Not only are their fins deprived of spines, but they are also speckled, a point which should readily assist in effecting their identification. Gudgeon haunt the shallows of rivers, especially in bright sunny weather; their protective mimicry is then unusually clever.

Turning to quite another family we come to the Perch group, in which we shall include the Perch proper, the Pike Perch, and the Pope or Ruff. All the members of this class possess spiny rays in the dorsal fin which, when stiffly erected, afford a suitable protection against the greedy propensities of such water pirates as Pike. The Perch is one of our finest-looking fish, being of a slaty-green lustre with six transverse stripes of brown and bright red under fins. Its spawn, which appears late in spring, is eagerly sought after by wild-fowl and swans; it is laid in long gelatinous bands somewhat similar to that of the toad, and may be found not far below the surface of the water, clinging to the weeds and rushes. The Pike Perch is a narrow, worried-looking fish of quick, alert movements; its capacity for swallowing large morsels of food is only equalled by that of the snake. The Pope or Ruff is of Perch-like build, but in more drabby colouring; it may be recognised as having the trait of two dorsal fins joined into one.

PERCH (*PERCA FLUVIATILIS*).

Pike belong to quite another class. Their long, barrel-shaped bodies of mottled brown and green closely resemble floating twigs; they are thus able to approach their victims without arousing suspicion.

The Stickleback is an ally of the somewhat romantic Flying Fish as well as the Mullet and the Seashore Blenny. Its pugnacious habits are the cause of much mischief to itself and its neighbours, whilst its greediness for the fry of all kinds of fish must have a far-reaching effect.

HEATHER.

HOW TO KNOW THE FLOWERS OF THE MOORLAND—I

By the Rev. H. PUREFOY FITZGERALD, F.L.S.

With Pho'ographs by HENRY IRVING

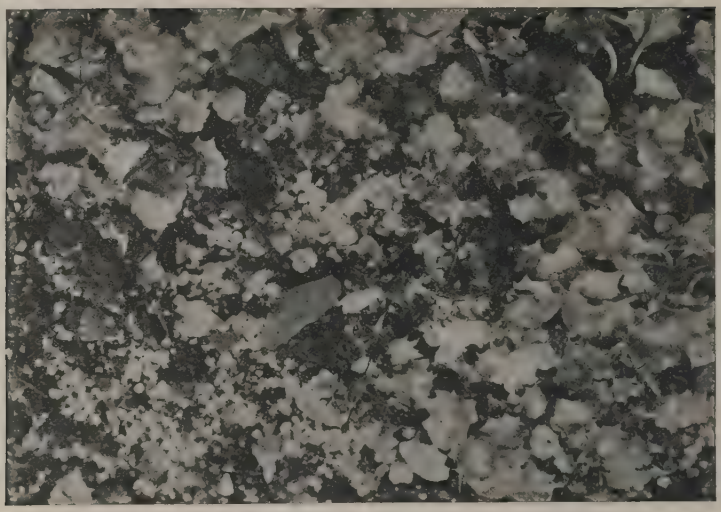
THE word moorland is a pleasing one, it suggests freedom and space, and where many delightful rambles may be indulged in, the air seems to be better than in most other places, and one's spirits seem to rise as one goes farther and farther away from human habitations. It is not everywhere that these large uninhabited tracts of country are to be found, but generally there are a few acres of wild wastes, which might be described as moorlands in miniature, and even these will supply us with certain plants which are typical of such places. One fact may be noted here which illustrates the methods which plants employ of adapting themselves to their environment; most of them (excluding all those found in the boggy places) protect themselves from loss of water in some way or another, some of them by having their leaves rolled up, so as to expose less surface for evaporation, in others the leaves fall off very early. On the wind-swept moors it is essential for the plants to do something of this kind, else when the drought comes it might fare badly with them.

HEATHER

The Heather, or Ling (*Calluna vulgaris*), is often confused with the Heaths or Bell-flowered Heathers, although the difference is somewhat great. In the Ling, for instance, the leaves are very short and placed in pairs opposite to each other, and also the purple corolla is shorter than the calyx, which is also coloured; the flowers, too, are arranged in small clusters all along the stems. In the Heaths, or Bell-flowered Heathers, the coloured corolla is always longer than the calyx, and the leaves are arranged in threes or fours along the stem.

The Ling is a member of the Ericaceæ, a family which includes many beautiful plants, such as the Azalea, Rhododendron, Arbutus, and Kalmia of foreign climes. Great use is made of the plant for thatching, making brooms, and so on, and it is only where the Heather grows that grouse and other moor game birds can live; the honey collected from its flowers has a great reputation, it is of a dark colour, and has a very distinctive flavour. The names Heath, Heather, and Ling all appear to come from old Anglo-Saxon words connected with heat and fuel, implying that these plants were used for firing in ancient days.

CROSS-LEAVED HEATH



IVY-LEAVED BELL-FLOWER.

Few people that have seen a large tract of country during August and September with the Heather in full bloom, varied with the lighter tints of patches of other Heaths, will forget the wonderful colouring effect; there are few sights in Nature more striking.

CROSS-LEAVED HEATH

The two common species of Bell-flowered Heathers are the Scotch Heather (*Erica cinerea*) and the Cross-leaved Heath (*E. Tetralix*). There need be no difficulty in distinguishing between them if the following points are remembered. The Scotch Heather has its leaves arranged in threes along the stem, whereas in the Cross-leaved Heath the leaves are in fours; again, in the former the flowers are of a reddish-purple colour densely arranged on the upper parts of the flowering stems, whilst in the Cross-leaved Heath the flowers are pink and in small clusters at the extreme ends. Attached to the pollen-bearing anthers in the latter are long, awn-like appendages which are absent in the Scotch Heather flowers. The stems of *E. Tetralix* are very wiry, and the whole plant is covered to a varying extent with downy hairs. In olden days, in Scotland, these plants were used as badges of certain clans—the Macdonalds took the Cross-leaved Heath, the Macalisters the Scotch Heather, and the Macdonnells wore the Ling. Two other species are to be found growing in England, but they are very rare, whilst Ireland can boast of three more.

WHORTLEBERRY

Growing in hilly heaths, woods and moorland tracts the Whortleberry (*Vaccinium myrtillus*) will be found fairly common; it also rejoices in the names of Bilberry, Whinberry, and Blaeberry. Formerly it was placed in the Heath family, but on account of some slight differences it, with a few relations, now forms the family of Vacciniaceæ.

The Whortleberry is a small shrub, growing nearly a foot in height, with several green, spreading branches; the leaves have very small stalks and are deciduous, falling off in the early autumn; they are toothed freely round the edges, and in this respect differ from the smooth leaves of the Bog Whortleberry (*V. uliginosum*). There is another noticeable difference between the two, in that the stems of the former are angular, whilst those of the latter are round. The Bog Whortleberry is not found excepting in the extreme north of England and in Scotland. The globular, greenish-white

flowers, with a slight tinge of red in them, grow singly on short, curving flower stalks, which spring from the axils of the leaves of the year's shoots; these are succeeded in the autumn by round, nearly black berries with a beautiful bloom on them—they are crowned by the four or five teeth of the calyx. The anthers of the stamens will be seen to bear two little awn-like appendages, somewhat similar to those found on the anthers of the Cross-leaved Heath, but a good deal bigger. The Cranberry (*Oxycoccus quadripetala*) is a near relation to the Whortleberry; it grows in peat bogs, and although it is fairly widely distributed throughout the British Isles, it is not very common, and owing to the drainage and reclamation of waste lands it is becoming less plentiful than formerly.

WHORTLEBERRY.

IVY-LEAVED CAMPANULA

Down near the rills on the moors and on the banks of streams in woods one of the most delicate-looking of our flowers will be found—this is the Ivy-leaved Bell-flower (*Wahlenbergia hederacea*). This little plant grows gracefully in a prostrate position, its stems and branches being not much thicker than a coarse thread; the bright green leaves are heart-shaped, and generally have a few angular teeth round the edges. The flowers are borne on threadlike stems, there being one flower only on each stem, and are of a delicate bluish-purple colour, about half an inch long and bell-shaped; when in the bud they droop, but become erect as they expand, and then often droop again as the fruit ripens.

This little Bell-flower is exceedingly attractive in appearance, and forms very graceful festoons around the stones and twigs amongst which it is growing.

H. PUREFOY FITZGERALD.

TWO COMMON THISTLES

By BENJAMIN HANLEY

With Photographs by the Author

IN Britain we have no lack of thistles of various species, and of these without doubt the most common is the Creeping Thistle (*Cnicus arvensis*), and one might say without fear of contradiction it is the most disliked—by the agriculturist especially—for whereas most other thistles, which live only two years, can be dealt with by cutting down either before flowering or before the seed is ripe,

SPEAR PLUME THISTLE.

and so prevent the thistle-down flying far and wide, this species spreads underground, and the more one cuts it down the more fresh shoots appear in new places.

This habit, which has earned for the plant its name, may be best noticed in the early part of the year, when the plants are only a few inches above the soil, for then patches many yards in area will be seen studded with young plants, and it is easy to tell that they have all sprung from one root. The male and female flowers are borne on separate plants. The former are rounded and the latter long and narrow. Another thistle almost as common as the last is the Spear Plume (*Cnicus lanceolatus*), but this is a much finer plant. It has received the first part of its name from the prickles on its leaves having developed into long, sharp spines, and if one stumbles upon a plant unawares no doubt the name will be thought appropriate. The flowers of this thistle, purple in hue, are much larger than those of the Creeping Thistle; the heads will measure an inch across. They are dearly loved by the humble-bees, which work early and late extracting sweetness from the nectared florets; sometimes indeed they fall asleep on the flower-head, and thus one finds them, drenched with dew, in the early morning, quite unable to fly until the sun has dried the moisture off them.

The name "Plume" Thistle is given because the hairs which compose the thistle-down are feathered, or plumed, whereas in the true thistles they are simple hairs.

Long before the majority of plants show any signs of life, this thistle may be seen spreading its leaves in green rosettes; and in late summer, crowned with a wealth of bloom, it forms one of the most striking objects of plant life.

BENJAMIN HANLEY.

CREEPING THISTLE.

SUNSET ON THE BAY.

From the Water-Colour Drawing by W. Telbin.

IN THE GLOXINIA THE PETALS ARE ALL JOINED.

CHAPTERS IN PLANT LIFE

VIII—THE EVOLUTION OF THE FLOWER

By S. LEONARD BASTIN

With Photographs by the Author

IN a general way, without the system of organs to which has been given the name of flower, the blossoming plants could not continue to exist. Of course, there are exceptions where plants producing flowers are not entirely dependent upon the offices of the floral organs for the perpetuation of their kind. Naturally, all annuals rely entirely upon increase by seed, but there are a few known cases in which perennial plants have persisted in a locality, and extended their field of growth, without ever having been known to propagate their kind through floral agency. The most singular instance on record is that of a little Oxalis introduced into Malta from the Cape before the year 1804. The species has spread along the shore of the Mediterranean by means of bulbs, but has never yet been observed to set seed in Europe.

A more homely instance of a plant which is practically non-seeding is to be found in the Lesser Celandine—a species which only on the rarest occasions produces fertile seed. The common mode of increase adopted by this plant is to be observed if the axils of the leaves are examined just after flowering time. In each recess there will be found a curious little tuber

about the size of a grain of wheat. These will subsequently fall to the ground, and, taking root, produce new plants. We must regard instances such as these as exceptions to that which is the rule amongst plants producing flowers.

Seeing that the flower is such an important feature of the plant, it is a matter of interest to consider the relations of the blossom to the other parts of the typical specimen. For the present purpose it will be all-sufficient to think of the flower as consisting of four parts. Starting from the outside of the bloom, we find the calyx; this consists of a number of sepals, which may be green or coloured. Enveloped in the calyx is the corolla formed of a number of petals usually coloured to a greater or less degree. In the centre of the flower we shall find a number of stamens, these enclosing in their turn the group of carpels which go to make up the pistil. As well, in not a few flowers, there are present a number of external appendages to which has been given the name of bracts.

BOUGAINVILLEA, AN INTERESTING PLANT WITH LILAC COLOURED BRACTS ROUND INSIGNIFICANT FLOWERS.

It has been stated that the calyx of the flower is in some cases green, whilst in other instances it is coloured and petal-like. To state that the sepal is green is the same thing as saying that the organs to an extent perform the functions of a leaf, and it is interesting to see whether it is possible to trace any further connection between the calyx and the foliage of the plant. The herbaceous Pæony is well worth an examination with this problem in mind. If a number of specimens of this flower be examined, it will be found that quite often the sepals of the calyx are modified leaves. Indeed, time and again it is impossible to determine definitely the exact nature of the organs, and the confusion is all the greater when, as is often the case, a large area of the leaf-like sepal is as gaily coloured as a petal.

In the common Moon Daisy of the meadows we may trace the whole course of the evolution of the green bracts which encircle the mass of ray florets. If one of the long-stemmed blossoms be examined, it will be found that, starting from the base, where there are the typical leaves of the plant, we shall find that there is a steady decrease in the size of the foliage as we approach the flower head. Finally the green processes lose their distinctive form altogether, until just below the flower they drift into simple lobes, which bear a striking resemblance to the bracts that encircle the flower.

We can thus trace a definite connection between the sepals of the flower and the foliage of the plant. Going beyond this, it is not a difficult matter to find a distinct relationship existing between the calyx and the corolla. The Tulip is an excellent case in point, for except that the sepals are, of course, on the outside of the petals, there is really nothing to distinguish them. Now, if we observe a large number of cultivated blossoms we shall certainly find that in not a few cases the sepals are partly or wholly green, proving beyond a shadow of a doubt whence they have their origin. Perhaps a still more striking proof of the leaf

origin of both sepals and petals is to be seen in the flower of the Summer Snowflake (*Leucojum æstivum*). Each portion of the perianth is tipped with a dot of pure green, and this spot stands up in vivid contrast to the snowy whiteness of the organ. For what special purpose this conspicuous marking of green may have been retained it is not easy to say; it is all-sufficient to indicate to the student the leaf ancestry of the sepals and petals.

A singular example of a plant belonging to an advanced family which has not found it necessary to produce any coloured sepals or petals for its flowers at all is to be seen in the Green Rose (*Rosa viridis*). As the name of the plant suggests, it is entirely without any tinted blooms. all parts of the flower being in the form of small green processes. If examined closely the organs are seen to be nothing more than diminutive leaves, and these even go so far as to retain the toothed edges which are such familiar features of rose foliage.

LEAF-LIKE SEPALS OF TULIP.

The change of the leaf into a tinted sepal or petal is not, after all, such a very remarkable happening, for coloured leaf-like organs which exhibit their character in all respects save that they are not green, are not uncommon. One of the most striking plants exhibiting this change of colour in the leaf is the *Bougainvillea glabra*, examples of which are to be seen fairly often in greenhouses. The real bloom of the Bougainvillea is insignificant, nothing like so striking in appearance as our Cowslip. They are developed in clusters of three, and being of a pale yellow, would scarcely be noticed amongst the foliage were it not that each group is enveloped by three conspicuous bracts. These bracts are closely on the lines of leaves, but are tinted in a highly attractive shade of lilac. As has been indicated in an earlier article, the Bougainvillea is well able to attract the attentions of insects by means of its showy appendages. A more familiar case of extra floral coloration is that to be seen in the *Salvia horminum rubra*, a common garden species.

This plant has adopted strange means to advertise the presence of its small labiate flowers. When in bloom the terminal leaves of each spike of this Salvia are tinted in the brightest pink. There is no doubt that these processes are true leaves, seeing that when traversing the whole of the stem it is possible to find leaves which are half green and half pink.

Further proof that the petals and sepals of the flower have their origin in the foliage of the plant is to be seen in the case of those species in which the calyx or the corolla persists after the blossom is "over," and for a time practically performs the offices of leaves. Thus with the Christmas Rose the petal-like sepals which go to make up what one may call the corolla, are peculiarly tenacious in retaining their position on the stem; they do not fade away after the maturity of the essential organs, but lose their whiteness and become green and leaf-like in appearance. Much the same process goes on in the case of the Hydrangea, a plant which, it is well known, surrounds its inconspicuous flowers with showy bracts. These bracts remain for a long time after the flower has faded, finally becoming as green as the leaves of the plant itself. Moreover, there are certain species of plants in which the coloured parts of the flowers gradually develop from very green material. This is seen in the case of some of the Guelder Roses (*Viburnum*), where the undeveloped floral appendages practically perform the offices of leaves during the early stages of their existence.

IN THE PÆONY THE LEAF ORIGIN OF THE CALYX IS CLEARLY SEEN.

The conspicuous and often attractively coloured sepals and petals of the flower are, after all, but of small importance when compared with the organs which go to fill up the centre of the typical bloom. We may, perhaps, regard the calyx and corolla in the light of advertising agents whose business it is to spread abroad the knowledge of the existence of the concern which they envelop. As is so well known, the essential organs of the plant consist of the stamens and carpels, these latter forming collectively the pistil. It is the duty of the stamens to produce the pollen grains, which, coming into contact with the ovules in the female portion of the flower, bring about the process of fertilisation. If all goes well the outcome of this union is the seed—the forerunner of the new plant.

It may not seem to be a particularly easy matter at first sight to determine what

may be the origin of the specialised male and female organs of the plant. As we have seen, both the sepals and petals of the flower show a more or less striking resemblance to the foliage of the plant, but one can scarcely say that there is much obvious connection between stamens. pistil, and leaf. None the less is it a fact which can be easily demonstrated that the leaf was the ancestor of even the reproductive organs themselves. In this connection the case of the so-called "double" flowers is very instructive. Here we see that the peculiarity of the blossom consists in a great increase in the number of petals, and these organs must have had their origin in something; as a matter of fact, they are degenerate stamens. The manner in which this change of stamens into petals takes place may be often well seen in the case of Begonias. It has been found to be almost impossible to establish an entirely double strain of these flowers owing to a strong tendency to revert to a single condition. Very commonly blossoms are to be found in a curious midway stage between the double and single condition, and when this is the case an interesting sidelight as to the connection between stamens and petals is to be seen. Some of the abnormal organs then produced are simply flattened stamens, very much like miniature petals save that the extremity is covered with a deposit of pollen. In other cases there is no pollen at all, and the process is formed of coloured tissue, being in fact a perfect petal on a miniature scale.

THE SNOWFLAKE, SHOWING GREEN TIPS ON FLOWERS.

Probably one of the most remarkable object lessons to be found in the vegetable world bearing on the origin of stamens is to be found in the case of the flower of the White Water Lily (*Nymphæa alba*). If a well-developed specimen is secured and carefully dissected, it is possible to sort out a most instructive series of organs illustrating the stages between the perfect petal and the normal stamen. Commencing

with the outside of the flower, we find the green sepal, which, in passing, it may be pointed out, is partially tinted with white. Next we shall find several rows of well-formed petals, the only strange point about these being that they steadily decrease in size the nearer one gets to the centre. If the investigation is pushed still further, it will be found that the petals become even more narrow, until they are strange linear processes which it is difficult to call by any name. At last one will be discovered which appears to be curiously thickened at the point, and if the termination of the organ be closely examined the presence of a small amount of pollen may be detected. The termination of this process, which can be called neither petal nor stamen, continues to be more and more modified as we near the centre of the flower, until it is resolved into two thickened parts, to be recognised as the anthers. When this stage is reached the petal-like lower part disappears and a slender thread takes its place, thus forming the filament, which goes to the making of the typical stamen. In the central rows of stamens it is not possible to discover the least resemblance between the petals and the male reproductive organs.

The Water Lily is not the only flower in which the intimate connection between the petal and the stamen may be traced. Something on much the same lines is to be seen in the case of certain species of Pæony, and other instances might be brought forward. It will hardly be necessary to bring forward further proof that the relationship between stamens and petals is a fact beyond question.

It will not be quite such a simple matter to trace in a clear fashion the leaf origin of the pistil as it has been in the case of the three other organs which have been dealt with. It sometimes happens in freak flowers that the stamens are transformed into carpels, and even on occasion strange processes have been found which bear a resemblance to both male and female organs. In the case of an abnormal Saxifrage mentioned by Kerner, it appeared that the anthers and ovules can be produced from exactly the same part of the stalk. There is, therefore, without doubt, a close connection between the stamens and carpels. It is interesting to push the matter still further and endeavour to find out whether we cannot find in a more direct way that the pistil is akin to the leaf.

There does not seem to be any flower in a natural state which offers us a complete explanation as to the origin of the female organs. Even in the case of most double flowers it is not easy to find an instance which helps us to understand the evolution of the carpels. There is, however, one double blossom which lets a good deal of light on to the problem, and this is the Cherry. The flower will well repay anyone who is interested in the matter to study a little closely. If the inner petals of a well-developed bloom of the double Cherry are torn away, it will be found that a small leaf occupies the place of the usual carpel. This leaf has the two edges folded towards each other, and the midrib is greatly prolonged, having a little knob at the summit. Now if this process be compared with the normal carpel of a single Cherry blossom, it is quite easy to see that the two sides of the leaf represent the walls of the ovary, whilst the elongated process can be none other than the style.

When the carpels have passed their maturity it is not at all an uncommon thing for them to develop into very leaf-like organs. This is the case in the seed vessels of the Pea, where it is discernible that the two sides of the pod are not unlike the lobes of a leaf joined together by a midrib. A most suggestive monstrosity is occasionally seen in the case of the Pea pod. This happens when for some reason the ovules fail to develop and the two sides of the pod do not close together in the normal fashion. When this is the case it is seen that the lobes of the seed vessel are still more leaf-like than is usually the case. Small projections are to be observed along the edges of this process, which may be called the carpellary leaf, and these will show where under ordinary conditions the ovules would have been.

For purposes of convenience the different parts of the typical flower have been dealt with in the order in which they occur in the actual specimen when a start is made from the outside. By doing so it has been made clear that every part of the flower has a most intimate connection with any other portion. In every case one

was brought back either directly or through some other organ to the leaf as the origin of that particular portion of the flower. It is quite certain that the foliage of the plant must have been in existence prior to the blossom, for whilst flowering plants can persist without blooms, they could not live at all without foliage or its equivalent.

The question as to the order in which the various parts of the flower were evolved is a most important one. Though the matter is still a controversial one, it is sufficiently obvious that the first portion of the flower to be formed could scarcely have been the calyx, the next the corolla, and so on. It cannot be advanced that these organs, which, after all, are only appendages, could have been formed in advance of the reproductive portion. As we have seen in an earlier chapter, the main object of the brightly coloured corolla seems in every case to be the means of advertising the presence of the essential parts of the flower, in connection with the scheme of fertilisation. Flowers with sepals and petals, but lacking the reproductive processes, are, of course, unknown in Nature, whilst there are many instances in which the corolla is quite absent. One cannot well escape the conclusion that

CURIOUS BEGONIA BLOOM.
The stamens in the centre degenerate into petals.

THE RELATION BETWEEN THE PETALS AND THE STAMENS OF THE WATER LILY IS HERE WELL SHOWN.

the stamens and pistil were developed from the leaf in the first instance, the protecting calyx and the inner row of petals coming later. If this argument be correct, we should call the midway organs which have been noticed in the Begonia and the Water Lily as degenerate stamens rather than as developing petals.

The subject of the evolution of the flower is a very profound one, and it is not possible to do more than hint at the wonderful process whereby the different parts of the blossom have been developed. To the general observer the most significant point is the manner in which at every turn one is brought face to face with the great importance of the leaf in the economy of the plant. It is in the leaf that the wonderful manufacture of the life basis of the plant—the green chlorophyll—takes place. It is from the base of the leaf-stalk that nearly all extensions of the plant arise. Not a few plants are able to produce fresh specimens on their foliage, whilst of course many of the low forms of vegetable life increase in no other way than by a system of leaf extension. We shall not be far wrong in regarding the leaf as the most important organ of the plant.

In considering the foregoing instance the student can scarcely fail to have been struck with the importance of those examples which are in some way departures from the normal. Certainly it seems that as the great scheme of evolution goes forward, the traces of the origin of things become less and less distinct. It will well repay anyone who is interested in the subject to keep a sharp look out for freak flowers, for, as we have seen, it is most likely that in these forms we shall find enlightenment as to the beginnings of the floral organs. The observer will find a much more fruitful ground for observation in the garden or greenhouse than out in the country. It is a well-established fact that under cultivation both animals and plants are much more prone to vary than when they are in a state of nature. We are not very clear as to the reason for this tendency, but the fact is beyond dispute. One of the most remarkable cases which has arisen as the result of cultivation, having a bearing upon the evolution of the flower, is the variety of Campanula known as the "Cup and Saucer." As in the case of the Gloxinia, which is illustrated, the five united petals go to the making of one bell, the five sepals being more or less joined together, but, of course, external to the corolla. In the form under notice it is the joined petals which go to the making of the cup, whilst the broad, flattened-out, abnormal calyx is responsible for the saucer. In this case the sepals have lost their green tinting, and have become blue or white as the colouring of the corolla may be. These matters show how important it is that the breeder of new kinds of plants should be acquainted with the scientific aspect of his work.

GREY MULLET.

FISHES OF OUR SEAS

Their Home Life

By F. G. AFLALO

II—BASS, GREY MULLET, GURNARD AND TURBOT

THE notion of any sort of home life in such restless, cold-blooded creatures as fishes may at first sight seem inadmissible. Yet some of us, who, for pleasure or otherwise, have made something of a study of fishes in their natural surroundings, know perfectly well that they can be domestic like other animals, and that their lives are governed by much the same passions and emotions. They are, in fact, actuated by hunger, fear, love and all the other incentives common to the lower creation generally. Of course, they have no moral code. Neither, for the matter of that, have many beasts and birds, save in the fertile imaginations of those who profess to write their life histories. Might is right in the world of waters. The stronger preys on the weaker, and the weaker must either hide or get away if he wants to escape destruction. They are not, however, devoid of what we call the domestic virtues, and parental affection is recognised in many of them.

The Sticklebacks and Gobies will guard their nests or eggs with great devotion, and the Lumpsucker, an ungainly-looking fish, will mount sentry over its eggs with such determination that not even the ebbing tide takes it from its post. It is foolish of the female to lay her eggs so near low-water mark, but perhaps she knows that her husband, and not herself, will run the risk of suffocation. Sometimes masses of these eggs are scattered by a storm, and the breaking of the waves is so violent that the Lumpsuckers cannot keep their place in the shallows. On such occasions, they have been seen, in the ensuing calm, hunting about for the lost eggs with every sign of distress. It has been said that the Lumpsucker even carries its young, clinging to its slimy sides, to places of safety, but the evidence on which this rests is not satisfactory.

In an earlier article attention was drawn to some types of wandering fishes, whose travels are perhaps more interesting than their home life. Now, however, it may be interesting to set down a few facts, as far as we know them, in the life story of the stay-at-home kinds that lack either the inclination or opportunities for extended travel. The Bass, the Grey Mullet, the Gurnard and the Turbot appear satisfactory representatives of these.

The Bass is sometimes regarded as a migratory fish. It is not found on the same grounds throughout the year. In a Devonshire river, for example, on the banks of which I have lived for some years, it is caught only in the warmer time of the year, say from April until September. Yet I long suspected that its change of quarters was only local, and that, instead of travelling hundreds of miles, like the Mackerel and Herring, it moved only from the deep to the shallow water and back again. This belief has more recently been confirmed by a study of the Bass in Turkish waters, where this fish attains to a far greater weight than with us, specimens of thirty pounds being not uncommon in the markets. One gentleman, an enthusiastic Bass fisherman who resides at Constantinople, catches these fish all the year round, only in winter he has to seek them in deeper water, that is all. Like many other fishes, these Bass go in shoals, those of the same size remaining together. They ascend rivers,

GURNARD.

BASS.

not like Salmon, for the purpose of laying their eggs in the gravel beds, but merely in pursuit of sand-eels and other food. In the Arun they wander for miles, as far, in fact, as the tidal limit, for they are caught above Arundel, amid scenes more suggestive of the haunts of Roach and Bream. They also love to play at the surface round rocky headlands, to rout in the fine gravel off sloping beaches, and to hunt for small shrimps and fishes among the wooden piles of piers and quays. They are not always very keen-sighted, and I have seen hundreds rushing up the river at Barmouth, passing by great swarms of unseen sand-eels playing about in the water less than a hundred yards away.

The Bass is a fish of warm seas, reaching its greatest perfection in the eastern Mediterranean. As far as our own coasts are concerned, it is abundant only in the south. North of the Thames and Bristol Channel, it is never plentiful, and in Scotch waters it is a rarity.

The Grey Mullet is a fish of very different habits—no dashing robber like the Bass, but a peaceful vegetarian delighting in weedy backwaters and regularly repairing year after year to piers or harbours where it can reckon on waste peas, potatoes and other soft food. This is why the jetty at Margate is such a favourite spot for its capture, for it regularly frequents the sea under the restaurant all through the summer, and very fine specimens are caught by resident anglers who have studied the conditions. The Grey Mullet, though essentially a sea-fish, can exist in brackish water, but it lays its eggs in the sea only. It grows to a weight of ten or twelve pounds, and is a nervous fish of slow movements when undisturbed, though quick to escape danger and a determined fighter when hooked. It has some extraordinary habits, of which the fishermen are not slow to take advantage with a view to its capture. Thus, it will not pass under a shadow, and the Turks catch it by spreading mats on the surface of the water on moonlight nights and drawing these gradually to land. The shoal is first seen and matting, perhaps a hundred yards long, is spread

over the water, with a fisherman at either end. If the water is deep, a boat at each end of the line answers the same purpose. The frightened Mullet steadily refuse to pass under the shadow of the mats and, dashing wildly to and fro, are gradually brought to the shallows. Then, just as they are nearing the dry land, they make a desperate attempt to jump over the obstacle and land in hundreds on the mats, from which they are easily discovered. Mullet are also, like cows, fond of rubbing their sides against posts, and of this weakness, too, advantage is taken by the fisherman wading at night in the shallows where these fish are commonly found, kicking up the sand so as to thicken the water, and then digging his heels deep into the ground, so as to make a hole rather wider than his leg. Presently he feels a Mullet rubbing against his ankle, and he must then stoop very quietly, get his hands round the fish and, with a sudden grip, lift it out of the water. Thus do the fishermen of the East (who know some things unsuspected in the more civilised West) manage to catch this most suspicious of fishes!

The Gurnard—there are many different kinds, but one will do for illustration—is a striking fish, brilliant red, and with an enormous head. It passes most of its life at the bottom of the sea, on the sand, but now and then I have caught one quite near the surface of the water. The lateral line is very conspicuous in the Gurnard, and one of the fins has tips which have been compared to toes. Indeed, all the Gurnards may be said to walk on the bottom of the sea, feeling their way cautiously among the stones and weeds, and instantly detecting the presence of the worms and shrimps on which they prey. They are lazy fish, and generally take a hook that is allowed to lie quite still on the bottom. Related to the Gurnards are two fishes known as Weevers, which are dreaded by the fishermen of all seas for the venom in their fins. These dreadful creatures lie still

TURBOT.

in the sand, and are caught both in the nets and on the lines. It is when removing them from the nets at night that the fishermen suffer most. Many experiments have been made with Weever venom, which is as active as that in many poisonous snakes.

The Turbot may be taken as the type of a very important group of fishes known, from their shape, as flat-fish. Our own Turbot, which is deep brown on one side and white on the other, is covered with rough tubercles and may thus be distinguished from the smooth Brill. Those from the Black Sea, which I have often eaten at Constantinople, have very large tubercles, and I have noticed these also on specimens in the fish-market at Dardanelles, which is supplied by local nets. The Turbot has no scales. It feeds on many small fishes, among them sand-eels and small flat-fish—and, in fact, fish constitutes its entire food. The spawning time in our seas is between April and July, and a female weighing twenty-one pounds will lay as many as 10,000,000 eggs, the majority of which, however, do not come to maturity. That is why many fishes have to lay such immense numbers of eggs, seeing that, with all the destruction done by storms and other fishes which feed on spawn, the race would otherwise die out—and Nature, as we know, is jealous of the type. Like all other flat-fishes, the baby Turbot has an eye on both sides, and also swims in the upright position. Then, after a few days, it gradually heels over on one side, and the second eye works round to the side henceforth uppermost. It would be of no use whatever on the side that lies in the sand.

NATURE "IN TOWN"

REGENT'S PARK

By ARTHUR SCAMMELL

With Photographs by W. J. VASEY

WHEN the Sun god turns upon his journey, and begins to look with a little more of favour upon this dejected latitude; when germs, many and various, begin to add cell to cell and to put on the dignity of organisms; when bats asleep in the roofs of barns stir in their dreams, and begin to shake the dust of winter from their wings, and squirrels and dormice open their eyes to take another look at the world; then man, too, arouses from his winter lethargy, he has new thoughts, and is impelled to different doings, and—amongst other enterprises he takes a Sunday morning walk. He is conscious, perhaps, only of a desire for exercise, or he thinks his dog would be the better for a run. But the man is greater than he knows: deep in his subconscious self there lurks a spirit—wild, roving, romantic, artistic, what not—which craves for life and colour and beauty, and so instead of lying long in bed, smoking in his back parlour, or walking the streets, he goes into the park; if he be a North Londoner, into Regent's Park.

One can but regret the name; what is there of beauty or worth that belongs to the Regency? The idea of antiquity is quite cut off; the period was not exactly great in Art, and as for Nature—Nature and the Regency!—the force of incongruity could no further go.

But the man who goes to Regent's Park to-day will see that Nature has forgiven George, and thrown her green mantle of protection over as much of his memory as attaches to the place. Perchance in some two thousand years' time—sins and follies and all else forgotten—the memory

of a mythical prince will live in the odour of sanctity as the founder of this beautiful pleasure ground, which will, of course, easily survive a mere two thousand years.

Our Londoner will enjoy his Park the more if he has a little knowledge of its history, and some imagination. It seems a pity that some brief printed record is not easily available (it might even be posted upon a board at the entrance). The visitor would then learn that in early times the Park formed part of a large oak forest, the property of the crown, and used as a Royal Chase. The oaks—several thousands of them—were cut down in the time of the Commonwealth for navy building; there is not an oak left. The land was afterwards cultivated in three farms until 1811, when the estate was "developed," and the Park formed for the use of the public, "H.R.H. taking a gracious interest in the proceedings."

The oaks are gone, but three large elms in the neighbourhood of the Zoological Gardens are relics of the days of agriculture; they once stood in the farm hedgerows.

The blood of the Anglo-Saxon ploughmen is still thick in our veins; and the idea at least of farming has a strong attraction for most Englishmen, not excepting the inhabitants of London; and so we cannot help feeling regretful for those vanished farms. The taste of "society" at the time would no doubt have scouted the idea, but I am sure that Tom, Dick, and Harry, then as now, would have been glad if something at least of that rustic life could have been preserved—some of the land continued in cultivation as a London farm.

I know that to many thousands of people it would have been a pure delight to walk in a lane, rutty as possible, and bordered with hedges of black and white thorn, dogwood, and hazel, blooming with honeysuckle in its season; from which might be seen the plough turning the crumbling earth, with rooks, belonging to carefully preserved London rookeries, following hard in the furrow; to watch

VIEW BENEATH THE TREES IN REGENT'S PARK.

THE WATER-GARDEN, REGENT'S PARK.

the growth and ripening of the corn, the reaping and the stacking; to have at least one great meadow, where daisies might grow long-stemmed in the lengthening grass, golden with buttercups, and sheeted white with the marguerites of June; then to hear the mower whetting his scythe, to smell the sweet scent of hay, and to see the snugly thatched rick beneath the winter elms. We might have had sheep, not only grazing in the summer, but folded on the frozen ground, and fed with roots from our own mound, and hay from our own rick, and have heard from the snugly littered lambing pens in March the tender cry of new-born lambs.

Was it quite impossible? less possible than the establishment and painful maintenance of tropical hot-houses and subtropical gardens, with potted tree-ferns, flannel-swathed palms, and grotesque orchids? At any rate, some of the farm buildings might have been left standing—(and used, one would say, for gardening purposes) weather boarded and red-tiled; with the grace of antiquity about them, they would have pleased us better than the smartest and newest of kiosques, bandstands and pavilions.

It is too late to talk of all this here; conceivably in the laying out of future suburban parks, this very general love of rusticity may one day be considered. Meanwhile we will try to make the most of what H.R.H. and Mr. Nash the architect have given us. Nature has well done her part, and it were ungracious to complain, for here is, indeed, a noble spread of elegant and cultured scenery, beautiful at all times and seasons.

Pleasant it is to enter from the street into a world of green; to see the prospect bounded by tree-tops instead of houses, and to let the sight travel to distant Highgate hill, crowned with lofty trees and loftier church spire; to take delight in undulating masses of foliage, and the bright colours of flowers; to see sheep at pasture under the trees, and eager boys hurrying to their cricket, each one certain of making forty runs at least; smooth, clean shorn lawns in the sunshine, and long grass under the

A LOVELY VIEW ALONGSIDE THE MAIN WALK IN REGENT'S PARK.

trees; to hear the songs of thrush and blackbird, and the coo of the ring-dove; to watch the half-tame squirrel stealing near to the passer-by in hope for crumbs or a nut, all the time with his eyes brimful of apprehension and nimble feet ready for an instant dash to the sheltering tree.

One naturally makes for the most distant part, as promising greater quiet, and the extreme northern side, bordering the Regent's Canal, is perhaps the most countrylike scene that can be found in the Park. A little thread of path runs along by the waterside, and the trees that grow on the steep banks are large and restful; whilst the beams of the setting sun, made more mellow by the veil of London smoke through which they pass, suffuse the foliage and bathe the trunks with golden light. I have seen a sycamore here on a May evening, before the leaves were fully grown, and with its horizontal branches thickly hung with bloom, struck through in a moment by these level rays, and all its yellow clusters lit up with magic fire. The effect lasted but a few minutes, but was of rare beauty, and an example of the "infinite variety" which those will find who watch and wait amongst the trees. An opposite effect of darkness is given by the sycamore in August twilights, when its grand trusses of foliage look sombre and heavy, as if carved out of solid masses of verdure.

There are great ash trees here, but the ash does not seem right to me in a London park; it is an austere, lonely tree, and belongs to remote and silent places, to distant upland pastures, or to the green banks which separate the farthest ploughfields from the downs; grey and orange lichens born of sunshine and pure rains should grow upon its trunk, and the complaining plover wheel her evening flight about its head.

A delicate sense of fitness should direct the planting of a park. There are many and beautiful forms of vegetable life which are quite in keeping with human neighbourhood, and are able to rub shoulders with a crowd with little loss of individuality or charm. The elm as a household tree; chestnuts, limes and sycamores as belonging to the garden;

white and Lombardy poplars (the black should not be grown anywhere), and the plane which has been made free of all our cities. Elder, lilac, and Guelder roses; with all our common garden flowers, except the Madonna lily—these homely things do not lose their quality by being grown in town, and a daisied sward is as right in St. Paul's Churchyard as at the foot of the Grampians. But I do not want to see the ash here, nor the oaks and beeches of the English woodlands, and the pine needs to be rooted amongst crags; these belong to their places like the wild flowers. I will go to them, but they shall not be brought to me; and let that man be anathema who takes the lady of the woods, the silver birch, from the forest and stains her whiteness with city smoke!

Perhaps the most attractive trees in Regent's Park are the wych elms. In the avenues of the central walk they alternate with the common and Cornish elms, assimilating and contrasting with both; for the wych elm is sister to the more familiar and robust *campestris*, graceful where he is sturdy, waving a hundred slender arms where he sends a sturdy column or two skyward. With drooping terminals and large, shapely leaves, a wych elm forms a perfect example of sylvan life and grace.

Two large and beautiful trees growing on the eastern side of the flower garden exhibit all the special characteristics of this species (though the complete and regular manner in which the outer branches sweep the ground may suggest the guiding hand of the gardener); the multitude of long, slender branches, all grace and lissomness; the bark of pure grey, boldly yet delicately carved into a thousand lines of ridge and channel, whilst the luxuriance of its May foliage is enhanced by myriads of leaf-like seed vesicles not yet scattered by the winds. Wide spreading like a forest oak, these shapely domes of verdure, with the long grass around them, and flowering cow parsley beneath their shade, form a picture which draws the steps again and again to this part of the gardens.

The modern practice of planting bulbs in the turf is twice blessed. Not only do we get the first spring green lit up with patches of colour—white and yellow and purple—and afterwards starred with

A MAGNIFICENT DISPLAY OF HYACINTH BULB BLOOMS

daffodils and jonquils; but when the flowers are gone, there is the long grass, and the flower of the grass, with many of those familiar pleasant weeds which elsewhere are prevented by the too assiduous lawn mower; thistles and dandelions, coltsfoot, sorrel, and here and there the grey-green leaves and upturned eyes of the speedwell.

Regent's Park is honourably distinguished amongst London gardens for the unmutilated condition of its trees. Massive horizontal limbs are allowed to extend themselves even across the walks; and the soaring habit of the elm is not forbidden. Topping and shrouding are almost unknown, and the public are liable to all the supposed danger of falling trees and branches; yet we do not hear of much slaughter.

It is good to know that the present superintendent, Mr. Webster—one of our greatest authorities in matters of forestry—has declared war against these botanical Bob Sawyers, who are all for improving trees into stumps. And as a number of metropolitan gardens, including those at the Tower, the Law Courts, and the Mint, are also under his charge, it may be hoped that for years to come many even of the old and decrepit trees of London, which under less wise management would have suffered, may escape the devouring steel. If only Mr. Webster's arm had been long enough to protect the Wood Street Plane!

Far away lies the country, the land of home; but here are still waters of Babylon to reflect the colours of evening clouds, and willows whereon exiles may hang their harps, and singing birds and bright flowers to alleviate the sorrows of captivity; and, better still, the sight of so many flourishing trees, pleasantly disposed in long avenues and darkling groves, crowning green hillocks and clustering at the water's edge to double their beauty by reflection; whilst in the notes of the birds, and the music of the wind in the branches, our ears may catch sweet echoes of the songs of our far-off Zion.

ARTHUR SCAMMELL.

THE LONG-EARED OWL

By BENJAMIN HANLEY

With Photographs by the Author

BRITAIN is rich in bird life and rejoices in having many species, but of all the birds classed as British there are none more interesting than the Owl family, and certainly none so useful in destroying vermin; yet in spite of this undeniable fact they suffer much persecution, mainly through ignorance, at the hands of people who ought to know better than to take the lives of such useful creatures. The pot-shot gunner, who delights to see birds boxed-up in a glass case rather than to study and watch them in their natural haunts, rarely lets a chance go by of adding another victim to his list should such present itself; whilst that grim gibbet of the woods—the gamekeeper's vermin pole—is usually adorned with one or two owls as feathered trimmings to the motley array of vermin, save in those cases where the keeper is a man of common sense and knows better than to rid himself of his most useful allies.

Not the least interesting of our Owls is the Long-eared species; in some districts, contrary to what is stated by most writers, this bird is even more plentiful than the Barn and Brown or Wood Owls, and a pair may be found in almost every pine wood. But as it is shy and retiring, being also much quieter than the Brown Owl,

YOUNG LONG-EARED OWLS—FROM LIFE.

and by no means so easy to see in the twilight as the Barn Owl, it is often resident in a locality without people being aware of the fact.

In colour it is buff on the upper parts with mottlings of grey and blackish brown and dark brown streaks, warm buff and grey beneath streaked with dark and small transverse bars; the beak is nearly black, and the eyes deep orange-yellow.

Sometimes when passing through a fir wood a sound almost like the barking of a distant dog falls on the ears; this proceeds from one of these birds, and if one looks up very probably it will be seen perched bolt upright on some high branch, staring down and every now and then making its peculiar note. The tufts of long feathers on either side of the head give it a very cat-like appearance, so one might say another of its notes—a kind of mewing—is not inappropriate.

This bird does not build a nest, but takes over the deserted one of a carrion crow or magpie; sometimes the drey of a squirrel is used. The eggs, which are white like those of other Owls, are four or five in number, and may be laid as early as March, but more frequently in April and May.

The young of this species are delightful little creatures to look at, but one should be chary of handling them. The specimens shown here made their claws felt through thick gloves when being taken from the nest to be photographed.

Whilst the most useful of the three is the Barn Owl, which feeds exclusively on vermin and insects, the Long-eared Owl is also beneficial and deserves protection, for its diet is largely made up of voles and field-mice; it also takes young birds, such as those of the finch tribe, on some occasions, but I have never known it guilty of killing game chicks—a crime which is sometimes laid to its charge and the Brown Owl's also.

DARBY AND JOAN.

HOW TO KNOW THE SHRUBS GROWING IN BRITAIN—IV

With Notes, descriptive and photographic, for their Identification in all Seasons of the Year

By HENRY IRVING

THE LAURELS

THERE is only one true Laurel, and that is the Bay Laurel. There are, however, several shrubs popularly associated in one way or another under this name—plants not in any way akin, belonging, indeed, to various families and orders. They are plants with laurel-like leaves, and that is all. All are evergreen. As is usual among evergreens, their leaves are thick in substance, leathery in texture, with often a polished surface. These obvious characteristics have been sufficient to bring about a rough-and-ready grouping under the common name. Unfortunately so, since it has become the occasion of quite unnecessary perplexity in distinguishing one "Laurel" from another.

So we have the Cherry Laurel, usually regarded as the Common Laurel, and the Portugal Laurel, both of which belong to the Cherry and Plum group; the Aucuba Laurel, from its mottled colour and markings referred to as the Variegated Laurel, which is of the Cornel family and so allied to the Dogwood; the Spurge Laurel of the Daphne family, closely related to the Mezereon of our gardens; and the Laurustinus, which were more aptly named Viburnum tinus, since it is of the same family as the Guelder Rose and the Wayfaring tree. Thus not one of these is a Laurel. The only Laurel is the Bay. With so determined and persistent a grouping of these plants under the common designation of "Laurel," it is surprising that some

SPURGE LAUREL.

others have not also been included, as the Magnolia, the Rhododendron and the Arbutus (Strawberry tree), since their leaves are just as distinctly laurel-like as are the others. The typical shape of the Laurel leaf is that of a more or less broad lance-head, tapering to a point at each extremity.

None of these plants, with the exception of the Spurge Laurel, can be regarded as native with us. That flourishes abundantly in many of our woods. The others are cultivated in gardens, and only rarely are they to be met with in a semi-wild state.

THE BAY LAUREL

This is the poet's Laurel. Since the time of the ancient Greeks this shrub, or small tree, has been held in veneration. Its berried twigs, twisted into a wreath or crown, were used to adorn the victors in the Pythean games; so the Laurel crown came to be regarded as the distinctive reward of valour or of scholarship.

With us the Bay is usually a rounded shrub only. It flourishes fairly well in sheltered places in the southern counties, but it can only just withstand our ordinary winters. The last winter, with its exceptionally low temperatures in these counties, cut down many a cherished Bay tree.

The leaves of the Bay are alternately arranged on the shoots. Their margins are without teeth. The most noteworthy characteristic of them is their fragrance.

BAY LAUREL

From this the shrub derives its by-name of Bay-sweet. Pollen-bearing flowers are distinct from fruit-producing flowers, and they grow on different shrubs. They are to be found in small clusters at the junction of stem and leaf-stalk. Each has four small petals, which are creamy white. The small oval berries ripen to a dark purple. They will, of course, only be found upon those plants that have borne fruit-producing flowers.

THE CHERRY LAUREL

This has come to be with most people the Laurel, though, as before stated, it is not a Laurel at all, but an evergreen member of the Cherry and Plum group. It is cultivated everywhere either as bush or hedge. Hardier than the Bay, it is not so hardy as its Portugal cousin. It seems to be peculiarly sensitive to impurity in the atmosphere, and becomes the forlornest of shrubs under the influence of the smoke of the town.

The twigs and buds are green. The leaves, which are arranged alternately, are of a bright yellowish green, polished and shining above, paler and matt beneath. The margins show small, irregular teeth. The leaf-stalks are short and stout. As with the Cherry, its near of kin, there are honey glands, but these are on the under side of the leaf-blade on either side of the base of the midrib, not on the leaf-stalks. They take the form of slight depressions, minute, green at first, changing to purple as the leaf matures, scarcely discernible in winter. The leaves, when bruised, emit a distinctive scent, as of bitter almonds, fatal to insect life in any enclosed space.

The flowers are grouped in erect, rather slender spikes, rising from the stem at the points of junction with the stalks of the preceding year's leaves. These spikes, like those of the Bird Cherry, comprise a central stem with radiating short branches, to each of which a single flower is attached. Each flower is complete with stamens and pistil, has small white petals, and is freely visited by insects for pollen and honey. The fruits, in branched clusters, are nearly as large as cherries, but less rounded, are black when ripe, and, like the cherries, have no waxy bloom.

PORTUGAL LAUREL.

THE PORTUGAL LAUREL

This rounded shrub, or small tree, is so closely allied to the last that it may be regarded almost as a variety. It may be distinguished readily.

FLOWERS OF PORTUGAL LAUREL.

The twigs and buds are a purplish red. The leaves are darker in colour, lacking the yellowish tint; they are thinner in substance, and harder in texture; also smaller, and, less space of stem intervening, they appear more crowded. Their habit is decidedly pendent. The margins are "fulled-out" and regularly serrated. There are no honey glands either on stalks or leaf-blades, and there is no smell of bitter almonds when crushed. The flower spikes are less slender, and the individual flowers more conspicuously white. The smaller fruits are longer in proportion to their breadth.

THE AUCUBA, OR VARIEGATED LAUREL

Though no relative of either of the preceding, this shrub, in habit and appearance, is remarkably like the Cherry Laurel. Its leaves, when not variegated, show the closest resemblance, in size, substance, colour, and surface. There are but few, wide apart teeth in the margins, scarcely noticeable when young, but frequently developing into broad indentations later. Conclusive points of distinction are found in the facts that the leaves are arranged in opposite pairs on the shoots, they have no glandular depressions on the under surface, and they emit no smell as of bitter almonds when crushed. They are, however, usually variegated, being grown chiefly for that reason. This variegation consists in white or yellow markings or blotches, irregular as to size and position, appearing as if the green colour in the substance of the leaf had been here and there chemically dispersed.

Pollen-bearing and fruit-producing flowers are distinct, and they appear on different plants. These flowers are not gathered into simple spikes as those of the Cherry and Portugal Laurels, but into loose, many-branched clusters, each branch bearing a terminal flower with others to right and left immediately beneath. Each flower has four

FLOWERS OF BAY.

small petals, claret-coloured or green, and inconspicuous. Flies visit the flowers for pollen. The rounded fruit is bright scarlet, roughened at the top where the style has withered, giving some resemblance to a large haw.

2 3 4

LAUREL LEAVES.
1. Portugal Laurel. 2. Cherry Laurel. 3. Bay. 4. Aucuba.

THE SPURGE LAUREL

This woodland plant is but a diminutive shrub growing only to a height of two feet or so. Its long, supple stems rise direct from the root, and carry their foliage chiefly at the top in the form of tufted rosettes. The stems are grey or whitish, coated with hairs. The leaves, whose margins are without teeth, are dark green and polished above, lighter and matt beneath. They are practically stalkless.

The flowers, which are complete with stamens and pistil, are tubular, having four divisions at the top after the manner of petals. They grow in small clusters at the junction of stem and leaf, are green, inconspicuous, and without scent. Yet they are freely visited for their nectar by bees and other insects, opening in March, as they do, when supplies are scant. It should, however, be borne in mind that attached to the flowers are modified leaves (bracts), and these serve to render their clusters more conspicuous. The small oval fruits are bluish-black. They are said to be poisonous to all creatures except birds.

THE LAURUSTINUS

This garden shrub, an evergreen *Viburnum* from Southern Europe, is only included here because of the implied association of its name. Its leaves are like those of the Bay. In distinction it may be noted that they are rather less pointed at the base, are without the characteristic fragrance of the Bay leaves, and are arranged in opposite pairs on the shoots. Its flowers are in close agreement with those of the allied Wayfaring Tree. They are complete with stamens and pistil, are tubular with five expansions at the top simulating petals, and are carried so as to form flattened clusters. In the southern counties they expand in late autumn, but farther north this is deferred till the following spring. HENRY IRVING.

TABLE SHOWING POINTS OF DISTINCTION IN LAUREL LEAVES

	Arrangement.	Margins.	Special Characteristics.
Bay	Alternate . .	Without teeth . .	Fragrant
Cherry Laurel . .	Alternate . .	Small irregular teeth .	Minute glands near base of under surface: scent of bitter almonds when crushed
Portugal Laurel .	Alternate . .	Full and wavy; with regular teeth.	More crowded, pendent, scentless
Aucuba . . .	In opposite pairs	Few wide apart teeth, chiefly towards the apex.	Usually variegated, scentless

COMMON GARDEN SNAIL (*HELIX ASPERSA*).

BRITISH SLUGS—I

By MAUD U. CLARKE

With Photographs by the Author

THE Slug family are a branch of the terrestrial *Mollusca*, in itself a division of invertebrate animals possessing soft bodies and an elaborated organisation that places them in a higher position than the insects, and only lower to that of the fish tribe.

In due form we have to recognise the Slugs as of the class *Cephala*, sub-class *Gastropoda*, of the order *Inoperculata* and sub-order *Pulmonata*. All four names are valuable as condensed explanations. The term *Cephala* implies a distinction between molluscs possessing definite heads that crawl on land, and the *Acephala*, or aquatic molluscs, that float on water and breathe through gills like fish. *Gastropoda* implies that the animal is a univalve mollusc, the shell being of one undivided form and having the lower surface of the body constructed as a foot-sole.

Inoperculata implies having no horny or shelly plate, called the *operculum*, with which many molluscs close the orifice of the shell for protection against enemies or for warmth during cold seasons.

The Snail has no true *operculum*, although it coats over the orifice with a secretion that hardens like a plate during the winter hibernation.

Pulmonata has reference to the animal being possessed of lungs.

The *Cephalic* molluscs have a distinct head and generally tentacles, or "horns," with so-called "eyes" at the tips or base. The "foot," or muscular disc, is capable of either crawling on the earth or floating on the water, the aquatic tribe forming a large separate order. When dealing with the question of the shell, we recognise a main division into two groups, those of the *Univalve* and *Bivalve*. The spiral shell of the Snail is familiar to every one as a representative of the *Univalve*, although perhaps the fact that the Slug family in several instances are also possessed of univalve shells may not be so generally known.

Throughout the great chain of differentiated species in the Nature world, we always find links, or connecting points, that show us the meaning of differences between specially developed families. Here and there, indeed, these links are

found to be missing, yet the negative truth is almost of as much value evidentially as the positive demonstration. Very frequently, however, these links are not demonstrated by the completed animal form, but are to be traced in the embryonic stage.

The tribe of the Sea Slugs, or *Nudibranchs*, in the embryonic stage are provided with a unispiral shell, whilst the *Limacidæ*, or Land Slugs, possess a shelly plate which is embedded in that part of the animal termed the "shield," or "mantle."

The position of the "shield" is either close behind the head, spreading backward over the body in oval shape, suggestive of a mantle over the shoulders, or at the rear of the animal, as is the case in the genus *Testacella*, or Snail Slugs.

This apparent variation in the position of the "shield" is, however, due to an abnormal development of the neck of the Slug in advance of the "shield." The *Testacella* hold an intermediate position between the *Helix* or Snail family that live in shells, showing them externally, and the Slug family, that only possess interior shells. The shell of the *Testacella* tribe is a truly formed one, often exceedingly beautiful and delicate in construction, and is shown externally, although the size in respect of the animal is certainly disproportionate. There is, however, no pretence of it being a "house of refuge" as with the Snail; it appears to be merely a protective plate that is always associated with the "shield" that overlies the vital organs of the animal, such as the pulmonary chamber, heart, etc. The noticeable respiratory orifice seen as a round hole on the border of the "shield" on the right side of the animal lies beneath the shell of the *Testacellidæ*.

The tribe of Snail Slugs, carrying their shells externally to the rear, are subdivided into three fixed species: (1) *Testacella haliotidea*, (2) *T. scutulum*, (3) *T. maugei*.

The first-named is a pale yellow slug about three inches long, found throughout England in established localities. The "shield" is nearly hidden by the ear-shaped shell, which is flattened rather than convex in form. The illustration * shows the shell apart from the dried animal, that is, of course, shrunk in bulk; but the photograph gives practically the natural size of both shell and slug, although not in the extended form.

T. scutulum is a darker-coloured slug, yellow or brown, of the same length, and somewhat similar shell. *T. maugei* is larger, about four inches long, of a dark-brown colour, with a much larger shell, more cylindric in shape.

This family, as many others of the Slugs, only go out after food at night, remaining below the earth surface during the day. They are carnivorous feeders, and attack conveniently sized earthworms.

Having marked their worm as satisfactory when encountered on the nightly prowl, the slug draws in the tentacles and dilates the mouth, pounces suddenly on the worm and proceeds to draw it in. This is a very leisurely performance, and on such occasions the expansive capacity of an invertebrate comes into full play of possibility. It is stated that an average life for these slugs is as long as five or six years.

In respect of the Land Molluscs generally, it has been noted that variations of colouring are more marked in the southern and western counties, when the type itself becomes rare. Mild climates produce stronger-coloured forms; colder climates the dull-coloured typical forms. Variations appear to be also produced by the geological conditions of the habitat and by differences of food.

The eggs of the *Testacella* are deposited at considerable depth in the ground, in galleries bored by the animals; they are coated with a calcareous shell that bursts when brought into contact with warmth. The young slugs hatch after ten to thirty-five days, according to the species, and are full grown in eighteen months, living five to six years. The south-west counties of England seem to be the favourite localities for this slug.

The two large classes of the *Limacidæ* and *Arionidæ* are each subdivided into what may be termed typically specialised Slugs.

In respect of shell formation, the *Limacidæ* come nearest to the *Testacellidæ* as possessing definitely formed shells,

* Photos taken from Natural History Department, British Museum, Cromwell Road, South Kensington.

although hidden beneath the skin. The shell lies beneath the "shield" of the slug, is oval or oblong in shape, white, and slightly concave. The concentric lines of growth demonstrate that the external shell, of which it is assumed this is the relic, was one spirally coiled. The *Limacidæ* is one of the groups which retain in the full-grown animal the primitive shell formed by the shell-gland of the embryo. It is said to be the shell held by the Romans to act as a charm against accident or disease, called the *Lapis limacrum*.

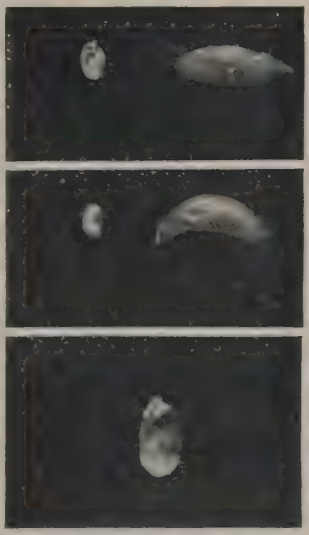
On the "shield" of these slugs the skin is marked by fine concentric lines, a distinctive character that parts them from the *Arionidæ* family.

A second distinction lies in the relative position of the respiratory orifice, or breathing hole, on the border of the "shield," which is placed behind its centre, whereas the *Arionidæ* have the orifice in advance of the centre, nearer to the head.

The third distinction lies in the perfectly formed shell. The class is divided into three groups: (1) *Limax*, (2) *Agriolimax*, (3) *Milax*, the two latter species varying from the first-named in certain important characteristics.

The *Limax* is a highly organised tribe having such great power of adaptability when transferred to other countries that the aboriginal species becomes few and the *Limax* increases its range of habitat. Their existence is recorded in very old fossil deposits, that of the German Lower Miocene, which is a fairly old family history for any animal to boast of.

SHELLS OF (1) *LIMAX MAXIMUS*, LINNE; (2) *AGRIOLIMAX* OR *L. AGRESTIS*, LINNE (Essex).



SHELLS OF (1) *TESTACELLA HALIOTIDEA*, DRAPARNAUD (Surrey); (2) *T. SCUTULUM*, SOWERBY (Surrey); (3) *T. MAUGEI*, FERRUSAC (Kensington).

Speaking from personal acquaintance of the *Limax* in captivity, as compared with the *Arion*, I call him by far the more interesting animal of the two. There is an alert rapidity of movement, a determination to remove himself promptly from trying circumstances that one can but respect.

If slugs can be said to be "keen," he is a keen slug; he is quick to discover change of diet, and never loses time in discovering that cooked potato or carrot has been placed among the cabbage or lettuce leaves provided. The olfactory sense appears to be sensitive. When handled for portrait-taking they quickly recover the sense of rebuff, and when moved into required position for focus from their own track of escape, pertinaciously set off again with a strength and determination one hardly credits the tribe with possessing.

The food and habits of the *Limacidæ* are exceedingly variable. Some are nearly subterranean in existence, only leaving their burrows in wet weather or at night. Some are practically omnivorous, whilst others are purely fungus feeders, all, however, having a lurking tendency towards cannibalism. In some species there is the predatory instinct displayed. In their turn they are preyed upon

LIMAX MAXIMUS (*VAR. TETRAZONA*), A SLUG HAVING TWO BANDS ON BODY.

by many birds, frogs, and toads, and by the blind-worm. The wood ant deals with the eggs to their diminishment, as do several of the flies.

Limax maximus forms a group showing a range of ten varieties, besides a list of sub-varieties that have been classified, with an admitted capacity for further extension. Beside the variation of colour, ranging through black, white, grey, brown, ochre-red, and a curious pale crimson (*L. maximus vinosa*), there is an elaboration of the markings on the "shield" and the longitudinal stripes on the body.

L. maximus sylvatica, a cold grey colour, shows two continuous bands of darker sepia-grey, strengthened with irregularly formed black markings, with a third band of broken markings approaching the "foot-fringe" or border of the "foot-sole." The "shield" shows light mottlings outlined sharply with black; the "foot-sole" a light yellowish-white. This is regarded as the typical form. The rugosities, or elevations of the skin folds, are fine and closely set together. The animal has no slime-gland, the mucus being produced from the pores of the skin. The "shield" is a broad oval extending backwards from the neck of the slug, always marbled or spotted. The dorsal "keel," or ridge, only extends upon the caudal extremity, or lateral inch of the total length of the animal, and is lighter in colour. *L. max. fasciata* has three longitudinal bands; the varieties *L. max. tetrazona* and *L. max. obscura* possess but two bands; in the latter they are rather blurred by a superficial pigmentation of the skin overlying the pigmented cells forming the bands. The theory of these and other markings is that the action of atmospheric conditions upon the areas of the animal's body, associated with main blood sinuses, produces an accumulation of the pigment.

The primitive stage is that of uniform colour—yellowish, greyish, or reddish; the second stage that of bands and markings of distinct character; the third stage, when overlying pigmentation of the skin diffuses the markings, or entirely obscures them.

In this country the ground colour of *L. maximus* is usually ash-grey, or the occasional brighter shades, as in variety *L. max. tigris*, which has only two bands, the upper, or inner, one the broader.

The hidden shell lies beneath the curved outline of the slug, over-arching the respiratory orifice. The colouring of the "foot-sole" of the species is light yellowish white, the average length from four to six inches.

In *L. max. cellaria* the longitudinal bands are broken into oblong, rounded patches, black on a pinkish-grey ground colour. As the name suggests, it is a frequenter of cellars, gardens, outhouses, etc., and not found in open country. This is a characteristic of the *Limax* tribe in general.

Limax flavus is a very handsome slug of golden-yellow colour, tinging to olive; the colour, being due greatly to the slime excretion and condition of the animal, varies in brilliancy of the yellow. When in captivity the colour becomes darker and more of the olive tint. The "shield" has a mottled appearance, varying the two colours; the "fringe," or muscular border adjoining the "foot-sole" of the animal, shows the brightest colour, whilst the "foot-sole" itself is nearly white.

The plantar surface is marked with transverse bars, which when seen in motion through glass show a most wonderfully fluent action, as continuous as the rippling of water in a breeze. In beautiful contrast with the body colour, the tentacles are transparent blue.

The eggs are deposited in moist crannies under logs, etc., between July and as late as December, in batches of half-a-dozen to twenty, hatching after forty to sixty days, the animal becoming fully grown in a year.

L. flavus is a voracious feeder, eating bread, cooked meat, and butter equally with mildew of walls or fungus of other kinds. Lettuce and cabbage are eaten in captivity, although fungi and lichen are preferred to green vegetation.

Limax cinereo niger is a class that contains the largest and most brilliantly coloured varieties of any group as represented by the Italian and other European forms. In the British Isles, however, the cool climate produces only the type form—black, and uniform dark colourings.

The type form shows the body a dark slaty black, with the clearly distinguished white dorsal line and central part of the "foot-sole," the outer borders of which are of similar dark colour as the body. The "keel," extending about half the length of the body, and sometimes the whole, is much accentuated towards the tail, showing a distinct series of elevations; the rugosities of the skin are as coarse as those of the *Arionidæ*. The "shield" is one colour, and never mottled as *L. maximus* and *L. flavus*, measuring two-fifths the entire length of the slug. Of the five sub-varieties *L. cinereo niger lactuosa* has been recorded in Yorkshire, Warwickshire, Staffordshire, Cheshire, and Glamorganshire. This variety shows a yellowish-white "keel" and dorsal line that only extends half the length of the body. The species is a fungi feeder, less nocturnal, and more active than *L. maximus*, an inhabitant of pine woods, hiding in the bark of the trees. In Italy the red, yellow, or parti-coloured varieties inhabit the plain, the darker coloured animals the colder mountainous districts.

The Tree Slugs, *L. arborum*, are another distinct group, slender in form and often of beautiful colouring and marking.

LIMAX FLAVUS (VAR. LIVIDA).

MORE ABOUT SEA "FIRS"

By S. F. MAURICE DAUNCEY

With Photographs by the Author and others

As was stated in a former article, the Sea "Firs" washed up on the beach are generally only the skeletons of colonies which have now done with the rough and tumble life of their ocean-

Photograph by A. F. Dauncey.

1. SICKLE CORALLINE.

world. Sometimes, however, colonies may be found there which are still alive, and occasionally such can be picked up even at the fishmonger's attached to shells.

But if you wish to study these interesting forms of lowly life with anything like care, you should not depend on specimens picked up thus by chance, but get live colonies from those natural aquaria—the rock-pools. Quite a number of Sea "Firs" can be found in these.

As soon, however, as you take out of the pool the shell, or bit of rock, or blade of weed on which the colony has settled, you are likely to be disappointed. Its lovely feather-like form has gone as though an evil magician had, unseen, waved his wand above it. But "the grace of the fashion of it" was not an illusion. It was due to the "pinnæ"—the feather-like growths from the branches of the main stem—standing out each distinct from its neighbour. But when the colony is withdrawn from the water they collapse into a formless mass. This is the case with the "Fir" known as the Sickle Coralline (*Hydrallmania falcata*), two photographs of which are reproduced. The first shows an aquarium specimen in which the natural

2. SICKLE CORALLINE (DRIED).

PLANT LIFE

FUNGI

Specimens required :—MUSHROOM, FLY AGARIC

Structure

Examine Mushroom. Make a longitudinal section through cap and stem. Note thick fleshy stem with cap. Underneath the cap are coloured plates running from the centre to the edge of cap. These are the gills.

Spores

Cut a piece of white cardboard so that stem of Mushroom can just pass through and stand for a few hours in a tumbler. A collection of purple dust is thus secured. These are the spores, and should be examined under a strong lens or microscope. If the cardboard be previously covered with gum the spores may be preserved.

Reproduction by Spores

1. Place spores in a moist mixture of leaf mould and manure. Note formation of white threads—*viz.* Mushroom spawn (*viz.* the mycelium).

2. Obtain piece of spawn brick and grow in well-heated mixture. Note mode of growth of fungus, particularly (1) junction of cap to stem, and (2) formation of ring on stem when fungus opens.

Study similarly the Fly Agaric (fungus with red cap flecked with white).

FUNGI

Mushroom

Fly Agaric.

Section of Fungus

Collecting spores

Micro-photograph by Frank Slade.
3. *PLUMULARIA PINNATA.*

MAGNIFIED PORTION OF SEA "FIR."

form is preserved; the second shows a dried colony in which the sickle shape assumed by the branches *when dry* can be seen. These colonies sometimes grow to about a foot in length, and are often mistaken for seaweeds.

On placing a colony, taken from the rock-pool, in your collecting jar filled with sea water, the little zooids will soon come out of their hiding-places in the horny zooid-cups; and you will be able, with the aid of your pocket lens, to make out certain facts about them, *e.g.* as to how they feed, and as to how they save themselves from being fed on.

For as you look you will learn that they are doubly equipped; they have arms of attack—their many tentacles; and, better off than yourself, their "skeleton" is their castle.

With their tentacles, fine as they are, they catch their prey, and the stinging cells with which they are provided paralyse their unhappy victims. The same thing happens with the fresh-water Hydra *Viridis*, which "plays" its capture like some skilful angler; but, even should the prey be immediately released, it invariably dies from the stings inflicted. In the illustration on this page these tentacles are shown in a greatly magnified colony of *Plumularia pinnata*.

4. *ANTENNULARIA ANTENNIA.*

The "skeleton," as it is called, of the whole colony consists of the same horny protective matter as the individual zooid-cups. The "feeding tube," to which reference is made below, is surrounded by it. For life is a struggle and a conflict even in these lowest grades; and while hungry enemies are out on the search for food, our tiny zooids would be snapped up as unconsidered trifles, were it not for the

enveloping sheath and the cups which give them protection. But even so, the Sea Slugs, with their lack of nice dis-

Photograph by A. F. Dauncey.
5. *ANTENNULARIA ANTENNIA.*

crimination, annex them—horny skeleton and all.

But our zooids are socialists, nor do they stay to distinguish between "mine" and "thine." The stem from which the branches grow, with their groups of pinnæ, is hollow, and so is the base of each cup. And through these channels the food caught and prepared by any individual zooid is distributed to the whole colony. And this is not more generous than necessary. So low down in the scale of communal life we find specialisation of function, and that there are some members which are incapable of obtaining food for themselves. But they must be fed—for, like that of the queen bee, their duty is the highest—to produce the eggs from which fresh colonies will be formed. One of these reproductive members, lettered A, is shown in the accompanying drawing (see page 1071) of a considerably magnified portion of the colony represented on page 776.

The eggs are carried away by the tides and soon hatch out into little larvæ These are at first covered with minute hairs, or cilia, by rapidly vibrating which the larvæ swim and reach a favourable spot for settling down. When they have done this they lose their cilia and form the beginning of a fresh colony.

Two specimens of *Antennularia antennia*, in some places popularly called Lobster's Horn Coralline, are shown in illustrations 4 and 5. The first shows a dried colony as generally found on the beach, with all the pinnæ rubbed off. In the second the colony was in an aquarium when photographed. Illustration No. 6 is of a Sea Oak Coralline (*Sertularia pumila*), a kind often to be picked up between the tide marks on the blades of large weeds, and specially interesting because of the phos-

6. SEA OAK CORALLINE.

phorescence of the edges of the zooid-cups. You need only wait till the evening, and then rap sharply the spray of seaweed on which your colony is growing, and you will have an evanescent fairy scene—the shining of a series of very tiny glow-lamps.

S. F. Maurice Dauncey.

MOONRISE ON THE HARBOUR BAR.
From the Oil Painting by Algernon Talmage, R.B.A.

THE PERGOLA WITH RAMBLERS.

HAPPY HOURS OF SUMMER

By R. A. STAIG

DAY awaking, slowly fades the sleepy haze of morning grey. Eastward a growing brightness and streaks of ruby in the clearing sky herald the rising sun. As the light spreads radiance around a rosy glow heightens on the face of peaceful morn. The breaking clouds are flushed with crimson. Again a cock crows and a neighbour answers him. Passing so lightly, the crisp morning breeze brings a faint rustle among the grasses. Care goes at its touch. Promise-laden, it whispers hope to the heart, a bracing message of fresh purpose, of the joys of living, of the goodness of the earth.

Starlings are already on the lawn. A speckled thrush has joined them, running forward to stop abruptly as if to listen; one swift wriggling peck, and the worm outwitted is taken like a flash. A blackbird slips up into the bushes uttering his rattling call-notes. Jenny wren is awake in the coppice, finches flit to and fro, and the chirruping of sparrows has begun.

Crystalline the ever brightening glare streams upward, illuming wide the heavens. Beyond the verdant hills, their

misty veils withdrawn, the sky is brilliant gold, and saffron tints suffuse the firmament above. Then comes the moment when, behind the gold-crowned ridge, the dazzling ray shoots up, close followed by the burnished sun.

In the dew-pearled pastures quietly the cattle have risen, contentedly they feed. With what a generous hand hath Nature jewelled the common grass, each moist, green blade bright-set with liquid glistening gems—soul sweetness from the ground effused to permeate the summer air with pure, refreshing fragrance! The timid rabbits frisk and scamper o'er the glittering lea. One moment a lapwing sweeps so near, you start at the strong swish, swish of wings; and the next it is high and away a field's length, doubling back "*pee*-weep, *pee*-weet." Far in the deepening blue a lark sings the matin of praise:

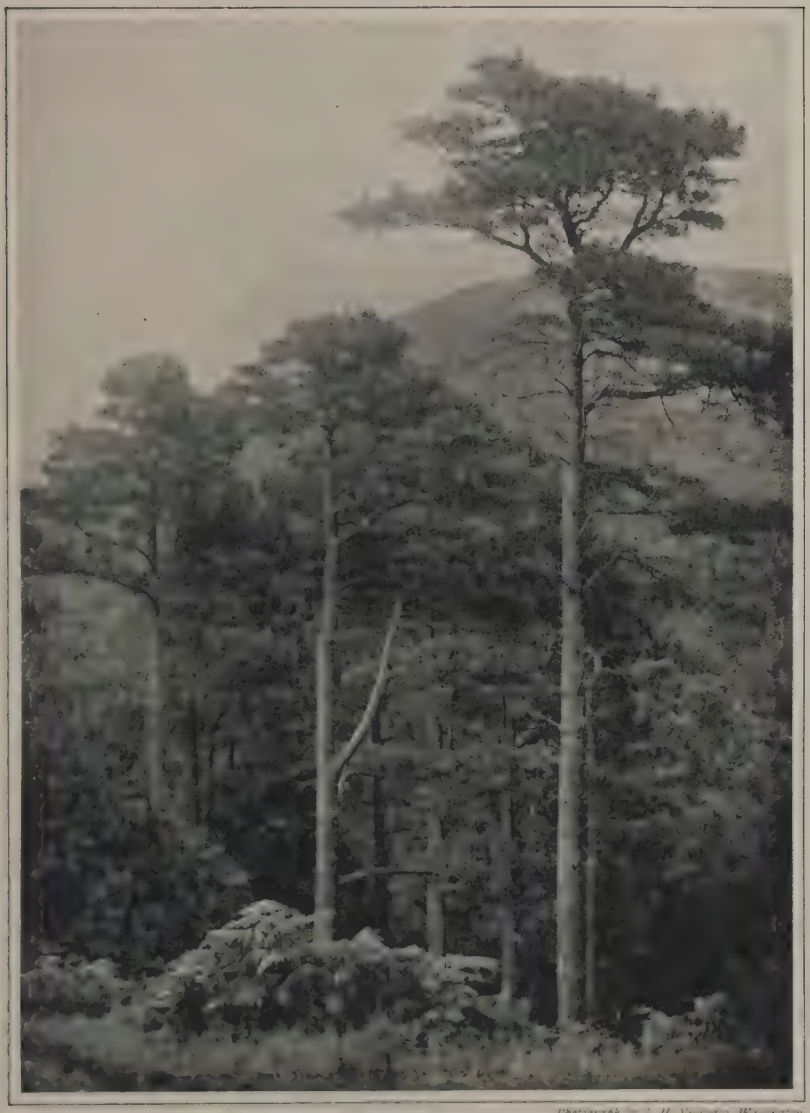
"Sweet is the breath of morn, her rising sweet,
With charm of earliest birds."

In and out among the hills, along a hollow, winds the stream. From the hot and dusty highway its tortuous course, like a broken thread of sparkling silver, issuing from the moor, is lost to view the while it tumbles splashing, frothing through the rocky glen; then, seen again, is rippling in the woods and gliding o'er the meadows. It draws like a magnet. Ever there so much for eye and mind to dwell upon; never is the summer day long enough by the stream.

Going one way the road leads between pasture slopes with yellow ragwort, sturdy Scotch thistles, and the lowly field madder

Photograph by R. A. Stazg

"AMONG THE MARSH PLUME THISTLES."



Photograph by L. H. Vandervoort, Washington.

TOWERING FIRS AND THE HEATHERY HILLS BEYOND.

Photograph by T. H. Yeldham, Wallington.

"A CLEFT OF VERDANT LOVELINESS, WHERE WAVY GRASS AND FERNS IN WILD PROFUSION O'ERHANG THE SILVERY WATER."

hidden among the wiry grass. Under the fervent dancing glare of the sun the whole field vibrates with life. The very atoms of the heated air resound. First one, then another, then many together, the grasshoppers shrill. At every step, up they spring and away—long, curved, flying leaps over the grass. Colour engrailed and spotted, quaint little hoppers scatter like sand before the foot; yellow-striped and coppery-gleaming flies moving on the flowers, and the tense buzzing of flies swiftly passing hither and thither and hovering in the air. Lavish spreads of purple thyme where the field dips down to the road, and the humming bees pollen gathering, intent, not a floret unexplored. Flower of the fullness and prime of summer, like the bees so reluctant to leave it, the spirit is enriched in contact with it. Its rare perfume is a power of good. Crossing the road, two white butterflies sport together, now rising, now falling, chasing each other round and round in giddy circles. Sudden, swift, and high slants the one out of sight; leisurely the other, fluttering to a purple knap-weed, shuts its wings, wheels half a turn, and motionless rests.

Now grown so tall and overhung with tresses rich of creamy crimsoned honeysuckle, the hedgerow forms a sheltering screen in the scorching hour. Freshness and beauty are of its leafiness, a wealth of variant green, of hawthorn interwoven with barberry and glossy undergold of beech and hazel. There white and pink the sweet wild rose; impulsively the hand goes out to clasp its sprays of floral loveliness. Hedge-sparrows pass in and out, wrens rustle among the leaves, greenfinches "twee, twee," and the yellowhammers are singing. Under the hedge and rearing high against it waves of grasses, club-tipped and panicled, foxtails, cocksfoot, silvered pink soft grass, brome dusty with pollen which falls in showers at the touch; and among the grasses bittersweet and the trailing St. John's wort entangled with cleavers, and long strings of blue vetch intertwining up the hedge. Tall in the ditch stands the

Queen of the Meadow crowned with corymbs of perfumed cream. Silverweed, shepherd's purse, rib-leaved plantain, and dandelions star every inch of available space along the dusty verge of the track. All is an undulating bank of verdure and flowers. Peerless blue of speedwell and the yellowed green of bedstraw commingling with the honey-scented crosswort; unbroken breadths of brilliant yellow lotus; touches of pink throughout—lychnis pink, and the bluish pink of crane's-bill.

The rose spray we plucked has its coterie of green aphides gathered around the stem, and beetles so tiny haunt its opening buds; on one green leaf a red spotted ladybird creeps, from another falls a caterpillar, and the one with the curled edge has a restive grub within. Every sprig of hawthorn has its golden weevils; and the forest of grass blades is a world of hidden creatures. Everywhere increasing crowds, but always space; flowers massed close together, more flowers pushing through their midst. Yet all this crowded luxuriance conveys no feeling of restriction and confinement, but rather of expansiveness and liberty, and it is impressive of an inexhaustible richness. Viewing it all, seeing the lightsomeness there, the heart is filled with a happy sense of the fullness and freedom of life—a healthy optimism begotten of the hedgerow in the sunny hour.

The open road has its charms, but the less trodden bypath is a stronger attraction—dustless, sequestered, more varied, more in the heart of things. By whichever way it takes you, there you walk in closer communion with Nature. Each prickly bramble arch or wisp of wayward grass ensnaring to the foot is a beautiful conspiracy against haste. It is the touch of Nature staying the step that you may see her beauties, know her better, read her wisdom, love her more.

Soft and springy, full of the sap of life, rushes surround the path through the marsh, a wilderness of deep green, spotted

Photograph by T. H. Yeldham, Wallington.

"GRASSY AND SOFT, THE PATH WINDS THROUGH THE GLADE AMID THE BRACKENS."

Photograph by R. A. Stalg.

"THE GLEAMING WAVELETS LAP THE STONY STRAND."

with buttercup gold and sprinkled with the pink of ragged robin. Tall beyond the knees, bending with height, and so thick together, the green rushes hide the spongy Sphagnum moss about their roots. Coloured like the moss, little frogs hop and leap among it, unnoticed ere they jump. White galium and blue forget-me-nots intermingle with the rushes, and here are orchids light purple lined and blotched, and the yellow racemes of bog asphodel; here, too, though sparingly, the Grass of Parnassus. How beautiful its floral cup indented, white, and delicately veined with green! But look within the flower, and see the nectaries around the centre, like tiny fans outspread and fringed with beads of amber yellow. Numerous as the rushes, stilt-legged crane-flies rise with an audible whir of wings—a short flight, like the slow brown butterflies which flutter an instant, then disappear. Now and then a pretty silvered blue flits swiftly by. Among the marsh plume thistles there is an endless procession in progress, a pageant of insect life. One moment it is the metallic splendour of a "greenbottle," and the next perhaps a striped hover-fly poised above a bloom, its wings spinning a halo; or some bee you do not know, or a weevil you have never seen, each with its own strange history, each with something for the loving eye.

Sweet on the ear falls the murmur of the rippling stream. There is joy in the sound of the crystal flow as it hurries onward over the stony shallows, bubbling and sparkling in the sunshine. Memory treasures its song; through the grey hour it sings again in the mind, calling forth so vividly all the happy recollections of the summer day. So clear the water you see the trout and parr dart off like shadows. A wagtail flies out from under the bank, an undulating flight across the ripples. You cannot see the nest hidden under the earthy ledge, but lying down and stretching the arm underneath at length you touch something soft and warm, a little family of four, late-comers. With the big cocksfoot grasses, pink yarrow and purple self-heal colour the bank. Sweet cicely and yellow mimulus flower along the water's edge beside the iris flags and branching burr reeds; white ranunculus o'erspreads the quieter reaches. Midstream a heron rises from his fishing, flapping heavily upwards to the tops of the tall trees opposite. With difficulty he alights, the pliant bough swaying under

him. Myriads of midges make the alder shade impossible—minute specks with speckly wings settling continually on the face and hands, swarms of the biting Ceratopogon. The larger forms are scarcely worse—gliding along the banks the swallows devour them in thousands, yet day after day they are as numerous as ever.

Away goes a brown dipper, straight up stream, skimming along the surface to a rock. A dozen times he bobs up and down as if curtseying. Wading into the water, buffeting the current with his broad white breast, one minute he is under, then up again, wading on, dipping his head quickly from side to side.

Nearing the woods the stream narrows, flowing between steep banks; a cleft of verdant loveliness, of matted woodbine and trailing bramble, where wavy grass and ferns in wild profusion o'erhang the silvery water falling in tiny cascades from pool to pool among the rocks. Grassy and soft, the path winds through the glade amid the brackens. Rare beauty is here; green of oak and spruce, darker hues of firs, and the green of grasses and branching bracken tall around the trunks, a blended tracery of variant foliage brilliant under the ethereal blue. Green mosses carpeting the pathway heighten the colouring and accentuate the coolness. "Coo-coo, roo-coo," the ring dove crooning; tits "chee, zee," sounds in the reigning stillness. "Koor-lee," high above the towering firs a curlew winging its way to the lone moor. Again the weird "koor-lee."

Beyond the pines the hills are tinged heath purple. You cannot see it, but it is there, yellow tormentil, summery dots amid the ling; and fancy hears again the old familiar cry, "errrr, beck, beck; goback, goback, goback," a grouse alighting on a heathery "knowe."

Wasps are everywhere. Not until the season's prime do the wasps appear. They come, as it were, to enjoy the cream of summer. There is a continuous file of wasps to and from a printed bill upon the telegraph pole. Bit by bit they are cutting it away, carrying it off to make a flaky papier-maché for the nest.

Livid scarlet poppies glow among the ripening corn along the margin of the fields. Scentless, bitter, and poisonous, there is a subtlety about the colour of the poppy which saves it. Common, but never commonplace, are the poppies. Great spreads of yellow as far as the eye can reach, the chervil or wild mustard scattered throughout the oats; and acres of potato blossom, some white, some light purple. How sweet the scent of the new mown hay from the fields where the workers toil in the sweltering heat! Bees are busy there on the purple heads of the uncut clover. Gad-flies torment the horses, gathering in swarms at every swish through the grass. Were it not for the troublesome flies, how pleasant the haying!

Lightly across the loch the cooling breeze fans the hot air. The gleaming wavelets lap the stony strand. The whole expanse bespeaks repose. The pine-clad slopes invite, red deer are yonder, but the heat is overpowering; it is enough to look there, then seek some shady nook beside the flags and gauzy dragon-flies to dream awhile.

Happy together, the sun-browned children gather harebells and "silver shekels" in the meadow. Corncrakes "crex, crex." In the west the sun sinks down; the daisies close, the clover leaves are folded, sleeping. Now is the hush of eve, with noiseless bats abroad and chafers droning past, and flickering brimstone moths. Later the thick-bodied Noctuas tap, tap against the panes. And through the night "tu, hoo; whoo, hoo," the tawny owl.

All too soon the days will pass, the days of butterflies resplendent, of glorious peacocks, admirals red, and painted ladies gay, and with the harvest hues the big drone fly will come upon the sunflowers and thistledown float through the air with summer on the wane. But that is not to-morrow, and even supposing, it will all return again, for in each green leaf, in each coloured petal, in every living thing, there is hope, always hope. Oh, happy, happy summer hours, so sweet and inspiriting!

R. A. Staig.

ARION ATERIMMA (BLACK) PARTLY EXTENDED.

BRITISH SLUGS—II

By MAUD U. CLARKE

With Photographs by the Author

ARIONIDÆ

THIS class of Slugs present very distinct differences of character from the *Limacidæ*, and as represented in the British Isles are subdivided into the two groups of *Arion ater* and *Geomalacus*.

The shell is reduced to some coagulated grains of calcareous pulp lying within the shell-sac beneath the hinder part of the "shield." When exposed to the air the grains harden, the condensation varying to some extent with the age of the animal. The body is rounded and stout, the skin-folds being cut and recut into coarse elevations. The "shield" has an indented or granulated surface quite unlike the ringed lines of *Limax*, and shows the respiratory orifice on the right anterior border of the "shield" nearer to the neck of the animal than the last-named species.

These two points of difference are easily to be decided in looking at the slug, and show to which of the two classes a specimen belongs.

The "foot-sole" is white or light with few exceptions, and shows a distinct pedal groove; the "foot-fringe" is sometimes noticeable as a distinct variation in colour from that of the body, as in the greenish-grey variety that has an orange "foot-fringe." This muscular border is further accentuated with fine black transverse lines.

This slug is nocturnal in habit, hiding from heat during daytime, and only emerging in cool, wet weather.

After days of drought in summer when rain threatens we often see black specimens of *Arion* at full stretch, travelling over the roadside grass after leaving their quarters in the ditches. They are voracious feeders, but their length of life is not estimated as over a year. Compared with *Limax* they are feeble in recuperative vitality, easily succumbing to injuries. A black *Arion* died within a few hours after a fall of eighteen inches upon a deal table, whereas a specimen of *Limax maximus* fell a height of five feet upon a gravel path, and seemed none the worse for it. In temper, I should regard the

Arions as sulky, and distinctly trying as camera subjects. When touched they contract into hemispherical balls, remaining so for a considerable time, keeping up a slow rocking movement like a boat in water at ebb-tide. Some suppose that this action is intended to intimidate the enemy; from the human standpoint it is eminently ridiculous and exasperating when you want to get a picture of *Arion* extended. The slug measures from three to five inches; the colouring is variable, the black and the red the two main types. They can be regarded as primary or climatic distinctions of colour—the black with cold and wet localities; the red with warm and dry ones. It has been noted that the pigment cells in the skin of red varieties are affected by a wet season, when the number of black slugs is increased. The American types show links with this group which relate our *Arions* with a tribe not originally shell-less, but possessed of spirally formed shells.

In addition to fifteen varieties of clearly differing colour scheme, there are other accepted sub-varieties. *Arion ater*, black, have a sub-variety *A. aterimma*, black, with the "foot-sole" dark also, a more uncommon slug. The specimen for illustration was one of these, the "foot-sole" being a dark slaty blue, from York district. *Castanea*, dark brown, with burnt sienna "foot-fringe"; *Plumbea*, purplish grey, with yellow "fringe"; *Rufa*, burnt sienna, with orange "fringe"; *Succinea*, bright yellow, with orange "fringe"; *Alba*, white, with yellow "fringe"; *Hiberna*; *Bocagei*; *Albalatoralis*, black and white, with orange "fringe"; *Bicolor*; *Reticulata*, yellow ochre, with redder "fringe" and broad brown patch on "shield" and back, tentacles black; *Fasciata*, type form *Brunneo-fasciata*, warm brown, dark on sides, paler below, "fringe" yellowish; *Marginella*; and *Maculata*.

The eggs are laid in great numbers in all seasons of the year, sometimes as early as January, under stones, wood and dead vegetation; twenty to fifty in batches that hatch out, according to temperature, in from thirty to fifty days. Four types of *Arion* stand apart from *ater* in certain important characteristics:

I. *A. subfuscus* is smaller, measuring from two to three inches, and does not

EGGS OF SLUG IN TURF.

A YOUNG SPECIMEN OF *ARION ATER* (VAR. BLACK) CONTRACTED IN ANGER.

contract into the hemispherical form when annoyed or at rest. The colour of the body is always darker than the "shield"—whereas in *ater* the colouring is uniform—and the species has no shell. The type form is said to be represented by *A. subfuscus rufo-fusca*, a yellowish-brown animal with dark bands on back and side and curving over the respiratory orifice on the "shield." The favourite food is fungi, these slugs eating the most poisonous kinds of the *Agarics* with impunity.

II. *A. hortensis* is a very familiar slug to all gardeners—far too much so for their equanimity. It is a small variety about an inch and a half in length, and possesses a very tough skin; this being a point discovered by gardeners, who do not proceed upon scientific methods of investigation, but avail themselves of a handy brick. *A. hortensis fasciata* is regarded as the type form, having a dark slate-coloured back and centre of "shield" with black stripes on the sides, and curving the border of the "shield." The "foot-sole" is always orange. There is no true shell, only a few loose granules in the shell-sac. *A. hortensis aurea* is the brightest coloured form, the back, "shield" and "foot-fringe" bright yellow; the sides of the slug are grey. It is most destructive in gardens to lettuce or strawberry plantations and such like; the species is also found in open country. When the gardener resorts to deliberate methods of self-defence, the animal's partiality for beer can be depended upon.

III. *A. circumscriptus* is another small variety said to measure only an inch. It is a slug associated with open country, although a consignment of turf can easily introduce it to the garden, as it inhabits grass fields and wayside land.

The animal is broader in build and paler in colour than *A. hortensis*, of pale cream colour shading to grey, darker on the back with a distinct black band passing round the body on the sides, the name being derived from *circum* (around) and *scriptum* (marked).

A distinguishing character is the white "foot-sole"—a really brilliant white—and the softer skin as compared with *A. hortensis*. The young slug shows a slight dorsal "keel," but this subsides when fully grown. Variety *A. circumscriptus grisea* is the most commonly known, having pale grey general colouring with sepia banding.

The type has pale brownish-grey back, dark brown banding with orange-yellow sides in the area lying between the band and the cream-coloured "foot-fringe"; the "foot-sole" brilliantly white. The slug is often found under rotting trees and logs, where it makes burrows in the damp soil; it is also found in association with mushrooms.

When resting, the animal takes the familiar *Arion* contracted form, with the "foot-fringe" spread out probably for more secure support. To the touch this slug is extremely sticky, and easily exhausted when exposed to sunlight, when it falls into twisted forms or stiffened unnatural curves.

IV. *A. intermedius*, or, as sometimes designated, *A. minimus*, has few varieties. Compared with *A. circumscriptus* it is smaller, and less striking in colour and markings, the banding being indistinct and colouring paler. The notable characteristic is the curious formation of the skin folds, that when the animal is contracted show as glistening points that sharply refract the light. The outline of the back shows a saw-like edge. The respiratory orifice is placed rather farther back than is usual with the *Arionidæ*. The colour generally a pale yellow-grey, sometimes showing faint bands or without. It is also an inhabitant of open land rather than cultivated, the food entirely fungi. The eggs are laid from August to January, hatching usually in three weeks. The shell-sac exists, but the actual demonstration of a shell is reduced to a thin lining of soft chalky substance.

SHELL FORMS OF (1) *ARION ATER*, MULLER (BATH); (2) *A. HORTENSIS*, FERRUSAC.

The shell seems to be constructed by an excretion from a great number of lime-cells that line the inner membrane of the sac, this organ of the animal having the capacity for collecting and condensing the calcareous substances that become absorbed by it.

One may even suppose that the shell was, in point of fact, a consequence, rather than a determinate purpose—that the lime-secretion being condensed in quantity, became first granular, then consolidated into granules that coalesced into the shelly plate of greater or less density.

Further development necessitated this plate becoming convex upward to accommodate the animal's organism. Instances have occurred where the shell of the slug has worn its way through the skin of the animal.

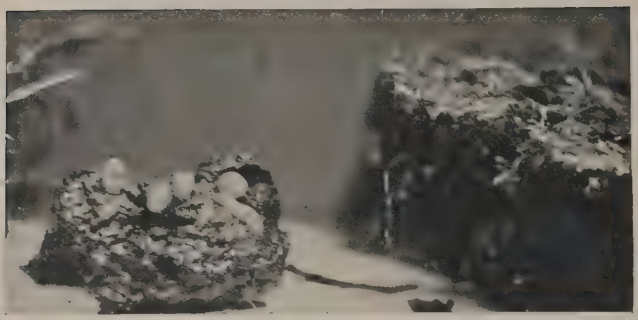
The second branch of the *Arionidæ* tribe, the *Geomalacus*, is represented by one species in this country, namely, *Geomalacus maculosus*, a spotted slug. The species is said to be dying out, with representatives only in West Europe. It is a lichen-feeder, and the general colouring shows a curious conformity with its surroundings when resting on the rocks among the colour splashes of these plants, the back of the slug being black spotted with white, and the sides yellow. The power to contract exceeds that of the *Arion*, for *Geomalacus* coils into a complete ball when disturbed. The respiratory orifice is anterior, like the *Arion*, but the "shield" is considerably larger, being a third of the extended length, and a shelly plate further differentiates the species. The shell is oval and flat, as solid as that of the *Limax*, and quite distinct from the loose granules of the *Arion*. The species has four varieties: the type form, *Geomalacus; G. fasciata*, a pale greenish-grey, with stripes on the back; *G. verkruzeni*, yellow-grey, with white spots on a grey back; *G. allmani*, dark grey, with white spots.

GENUS "AGRIOLIMAX" AND "MILAX" (THE FIELD SLUGS)

These slugs stand apart from the true *Limacidæ* in the coloration, in the invariable absence of the longitudinal banding, and in the distinct character of the milky white slime. They are smaller in size, and show a white, uncoloured ring round the respiratory orifice. The body is flattened on the sides, seen most noticeably when the slug is moving, and "keeled" towards the tail.

The "shield" is a third, or more, of the length of the body, rounded before and behind, and marked with the fine concentric lines of the *Limax* tribe.

The species *Agriolimax agrestis*, subvariety *lilacina*, is a variation on the pale ochre-coloured type form, being a uniform pale grey tinged with a lilac shade; the body is marked with long-shaped blotches of a rather darker shade, the head and "tentacles" darker, whilst the "keel" shows lighter. The white ring that surrounds the respiratory orifice is clearly marked. It is a highly organised member of the slug tribe, and shares the power of adapt-



EGGS OF *LIMACIDÆ* AND YOUNG SLUG ONE DAY OLD.

ability to new surroundings characteristic of the *Limax*.

Owing to its habit of frequenting cultivated land it has become colonized in many countries, ousting the native slug after a time. It is a most destructive slug, moving rapidly in the fashion of the *Limax*. In woods and shady places the pale varieties abound, the darker occurring in the open. The coloration goes through considerable change, passing from light to darker tones in the change of the seasons. A pale cream-coloured animal in the spring becomes a rich brown in autumn, so the exact identification of a variety is complicated by the modifying conditions of time and place.

The illustrations on page 1067 show the shells of *Limax maximus* and *Agriolimax agrestis* in contrast; those of the latter are very beautifully formed little shells of pearly white colour.

Agriolimax lævis is a very small slug of the same species, of uniform chestnut-red colour, having a large "shield" that appears situated in the middle of the body when the abnormally long neck is extended. There are two varieties besides the type form: one mottled brown, *A. lævis maculata*, and a grey and fawn-coloured animal, *A. lævis grisea*.

GENUS "LIMAX GAGATES," OR "MILAX"

This is one of our uncommon slugs, of which the type form is black in colour, though more often represented with us by pale grey or brown.

The species is regarded by some writers as a link between *Limacidæ* and *Arionidæ* on account of the "shield" being granulated in the style of the latter animal. In most other respects it is definitely related to the former class, save in three important departures: (1) The extension of the "keel," which runs the whole length of the back from "shield" to tail; (2) the elevation of the central part of the "shield" into what appears a secondary one of smaller size lying upon it; (3) the markings of the "foot-sole" being chevron-shaped instead of transverse.

The elevated portion of the "shield" is further emphasized by a horseshoe-shaped ring that almost surrounds it. The respiratory orifice is behind the centre of the "shield" border, which is characteristic of the *Limacidæ* and not of the *Arion*.

It is a carnivorous species, rarely eating vegetable food, slow in movement, possessing a thick skin; the average life is some years.

Milax gagates is a slender slug with a pronounced dorsal "keel," sharply truncated at the tail. It is a nocturnal species, living below the earth's surface and feeding on decayed vegetable matter, and is also most destructive to bulbs and tubers of plants. The animal changes diet on occasion, preying on small snails and slugs.

The young slug shown on this page was hatched out in captivity, the eggs, five in number, having been found in advanced development in some imported turf. I could not determine the exact variety in so early a stage, save that it belonged to the *Limacidæ*. When touched it contracted into position of *Arion* for a brief space of time, showing a sharply

formed "keel" the whole length of the back; but the "shield" was marked with concentric lines, and respiratory orifice posterior. The colour, a uniform pale grey, lighter on the sides, with darker markings on the "shield," with the "tentacles" a dark slate-grey; the length about half an inch. The movement was as rapid a day old as that of a full-grown slug.

Milax gagates, when resting, contracts more into the rounded form than any other British *Limax*. *L. maximus* and *L. flavus* lie curled head to tail in the fashion of a dog, the detached "shield" border lying out in a way suggestive of a dog's ears.

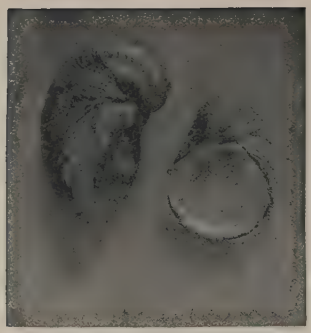
The variety *M. Sowerbii* shows the "keel" paler than the body, most prominent on the back, and disappearing towards the tail. The colouring is grey, tinged with yellow, as small pigmented cells that show as dots; the "keel" is amber-coloured, and the "shield" granulated in surface as the *Arionidæ*. It frequents stiff clay soil in gardens, lying in worm-burrows during the day.

Although I have made no reference to the anatomical structure of the slug tribe, as not being of general interest, the consideration of the mouth of the animal is worth a few words. Unless slugs have been studied in captivity, it may not be known that you can distinctly hear them feeding; and watch the deliberate series of circular bites enlarging the gap in a lettuce leaf. Regular sharp little sounds are made with precision at each bite, and with each movement the mouth can be seen opening as a dark cavity between the two curved "lips."

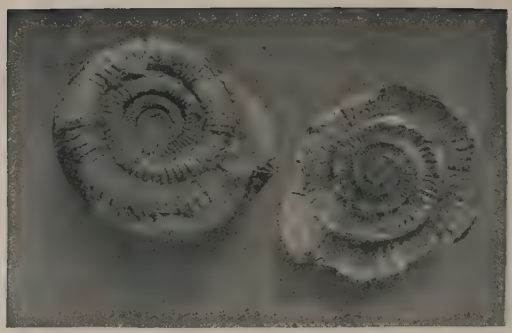
The slug is possessed of what is termed a "lingual ribbon" or jaw plate, that is set with exceedingly fine sharp teeth. The variations between species is determined in exact study of the subject under the microscope, when these jaw and teeth variations from typical form are taken into consideration.

MAUD U. CLARKE.

ARION ATER: VARIETY SHOWING BLENDED COLOURING OF GREENISH GREY WITH ORANGE FOOT-FRINGE.



GRYPHEA INCURVA—ONE SPECIMEN SHOWING OPERCULUM, FROM THE LIAS.



AMMONITES COMMUNIS, FROM THE LIAS.

FOSSILS AND THEIR STORY

By F. MARTIN DUNCAN, F.R.P.S.

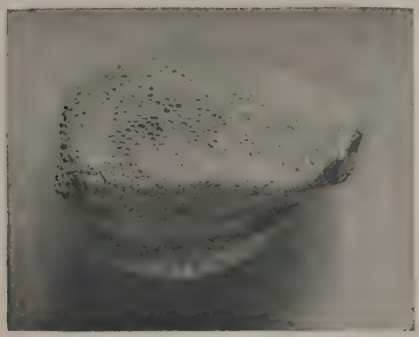
With Photographs by the Author

FOSSILS are the pictures wherewith Nature has illustrated her great stone book, the pages of which are the mountains and valleys, the cliffs and seashore, the peat-bog and river channel; pages that are eloquent with the romance of the past history of this earth, and which are ready to yield something of their romance to every intelligent observer.

With the aid of these fossil remains, it is possible to reconstruct many a page of the history of the Earth's past, and to learn what the plants, animals and insects were like that lived during each geological period, and also what climatic conditions prevailed; while perhaps the most interesting and valuable of all, is the fact that by careful studying and comparing these same fossils, we are able to trace the origin, ancestry, and gradual evolution of many of the forms of life which inhabit the earth to-day.

Fearsome, indeed, must have been many of the creatures which lived during some periods of the earth's past; creatures more weird in appearance than any that have been drawn by the facile pencil of that inimitable caricaturist of geological remains, Mr. Lawson Wood; and we may well be thankful that they have ceased to exist. As we gaze upon the gigantic fossil remains of these monsters of the past, we cannot help wondering if such ancient and practically universal myths as the dragon story had not an origin in literal fact, and are the dim echoes handed down from the days of Palæolithic or pre-Palæolithic Man.

It always seems to me very strange why so many people labour under the absolutely mistaken idea that geology is a "dry-as-dust" sort of hobby, and one out of which little or no interest is to be extracted. As a matter of fact, it is one of the most absorbingly interesting hobbies one could wish for. Think for a moment what this term geology means—it is formed from two Greek words, which literally mean earth-science—and you will at once realise what a wide field of interest it covers. It is the science which will help us to understand how every mountain and valley, moorland, cliff and marsh,



FAVOSITES—A FOSSIL CORAL FROM THE UPPER SILURIAN.

has been formed, and it will help us to a fuller appreciation of those vast changes, climatic and geographical, through which the earth has passed.

In "Cliffs and their Story," "Sand Dunes," and "Nature's Masonry" we have gained some insight into the methods which Nature employs in sculpturing and moulding the face of the earth. Now let us turn our attention to the fossils which we shall find imbedded in the rocks of the different formations, and try to piece together the wonderful history of the past. In most of the sedimentary rocks, fossil remains, usually consisting of bones, shells, teeth of animals and the remains of plants, are to be found, and with their aid it is possible to reconstruct the creatures and plants that were peculiar to the formation in which they are found.

Casually glancing over a large collection of fossils, we cannot help noticing that many have a more or less distinct likeness to some of the animals and plants that are still in existence; but examples of exact resemblance are confined chiefly to the newer deposits, and even here are comparatively rare.

It is very interesting to observe how, in the struggle for existence, it is the simpler forms of life which have persisted with comparatively little change through past geological ages, while the more complex forms of life have either become totally extinct, or have undergone considerable modification; while a closer examination of these fossils will demonstrate and deeply impress the circumstantial truth of Darwin's theory of Evolution. Nor must we forget that it is by the careful examination and comparison of fossil remains that the biologist has been enabled to determine the ancestry and evolution of many forms of life to be met with to-day.

It is impossible, in dealing with the history of the earth, to give any numerical idea of the passage of the ages, and therefore it becomes necessary to divide geological time into periods or formations. These periods have been definitely fixed by the character of the rocks and the fossil remains peculiar to each, and may be divided into three great eras. These three great eras have been given names of Greek origin: the first has been named

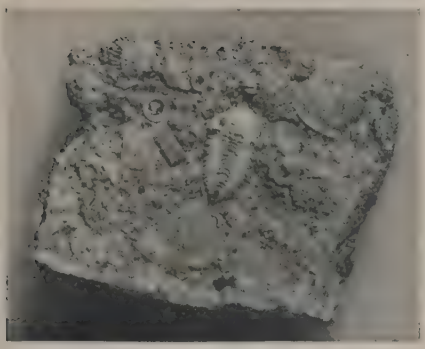
NEUROPTERIS—A FOSSIL FERN FROM THE COAL MEASURES.

Eozoic, which means dawn of life, from the Greek *ēos*, dawn, and *zoē*, life—and of the life of this period we have still a good deal to learn; to the second era the name Palæozoic, meaning ancient life, has been given, and is derived from the Greek word *palaios*, ancient; the third era is called Neozoic, which means new life, from the Greek *neos*, new, and *zoē*, life; and emphasizes the dominant character of the forms of life represented by the fossils. To further facilitate the geological record of the history of the earth, each of these great eras is divided into successive periods, while the rocks peculiar to each period comprise a system. During each period slight geographical changes, accompanied by the change or modification of the existing forms of life, took place, and these are used to indicate the limit of an *epoch;* while the great rock-masses, containing the physical and life-history of the era, form a group of strata. Thus the Neozoic era in Britain is divided into two groups of strata, one called the Cainozoic or Tertiary, the other called the Mesozoic or Secondary. The Cainozoic group comprises five geological periods, while the Mesozoic comprises three, and these again are divided into epochs. The Palæozoic era is divided into two groups—the Newer and Older Palæozoic, each comprising three periods; while the Eozoic has one period—the Archæan.

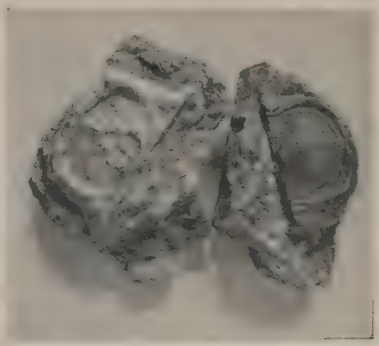
SHARK'S TEETH, FROM THE CHALK.

FOSSIL SPONGE IN FLINT CHALK.

The Archæan or pre-Cambrian rocks, forming the Eozoic group, are the oldest known rocks in Britain, and are now only naturally exposed to view in a few localities where they originally formed very high land, or have become exposed by excessive denudation or great faulting; but in most places they are very deeply covered by the deposits of the newer formations. They have undergone considerable changes, and are still a somewhat ill-defined group. Of the rocks forming this group, the Gneiss is probably the oldest, and it presents the same general characteristics wherever found, although it is not all of the same age, some probably being, comparatively, more recent. According to Professor Bonney, "Gneiss may be, if not actually part of the primitive crust of the earth, masses extruded at a time when molten rock could be reached everywhere near to the surface." Between the Gneiss and the unmistakably sedimentary rocks frequently lie enormous masses of Crystalline schists, sometimes several thousand feet in thickness. No fossils having been found in them, their origin is often difficult and sometimes impossible to determine, and but little has been discovered about them. The upper schists probably represent ancient limestones, clays and sandstones; while the lower Crystalline schists are generally intensely folded and crumpled, and are probably of igneous



CALYMENE—A TRILOBITE FROM THE UPPER SILURIAN.



INTERIOR AND EXTERIOR OF SHELL OF *STROPHOMENA*, FROM THE SILURIAN, FORMATION.

origin. All the indications point to a period of stress and widespread volcanic action. Of fossil remains of animal life traces are few and exceedingly doubtful.

The Palæozoic era is one of very great interest, for it is in the Lower Cambrian strata that the earliest well-preserved fossils have been found ; and in the rocks of this era have been discovered the fossil remains of many extinct species. The most important fossils confined to the Palæozoic rocks are known as Trilobites, and are the fossil remains of the ancestors of the crabs and lobsters. The name Trilobite refers to the peculiar structure of each successive segment of the animal's body, each segment being divided into three portions or lobes. These creatures had on the chest and tail segments of their bodies, feet adapted for swimming, and gills for breathing ; and, from the number of their fossil remains, must have been very numerous. In general appearance, apart from their tri-lobed segments, they are rather like very large specimens of the so-called wood lice—which are really Crustaceans—that live under the bark of old, decayed tree-stumps.

Resting conformably on those of the Cambrian system are the rocks belonging to the Ordovician or Lower Silurian system. From the fossil remains and general character of these deposits it would appear that the geography of Britain, while these rocks were being formed, presented the appearance of a deep-sea archipelago, somewhat like the Malay Archipelago or the Kurile Islands, the islands being chiefly volcanic. Some gigantic Crustacea called Merostomata are found in these deposits, and may be considered an ancestral type of the King-Crabs. Trilobites were also numerous, and the pretty double shells of Strophomena, a Brachiopod shell-fish, which existed during some four geological periods —from the Ordovician to the Carboniferous period.

It is in the Silurian deposits that the first fossil remains of the fishes and land plants appear. The pretty little trilobite called Calymene was not uncommon, and Sea Lilies (*Crinoids*) abounded. Corals were very numerous, and must have formed considerable reefs in just the same manner as they are doing in the tropics to-day. Amongst the Corals characteristic of this period, are the Honeycomb (*Favosites*), the Chain Coral (*Halysites*), and Omphyma. Amongst the fossil Hydrozoa, the beautiful little Monographtus belongs to the Silurian formation. The ancestors of the Cuttle-fish and Nautilus of to-day were well represented in the Silurian seas, their shells coming down to us most beautifully preserved.

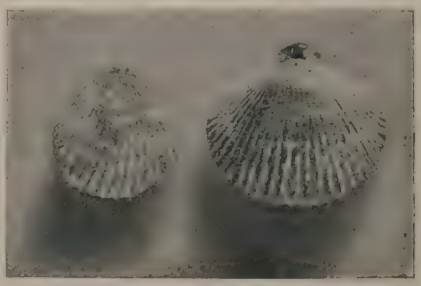
To the enthusiastic fossil-hunter the Silurian deposits of Shropshire, North Wales, the southern part of the Lake District, and the southern Highlands of Scotland offer a rich harvest of most interesting specimens.

In Scotland, South Wales, and Here-

VOLUTA—A BEAUTIFUL FOSSIL SHELL FROM THE BARTON CLAY.

fordshire an interesting set of rocks come above the Silurian formation, and are known as the Old Red Sandstone. The rocks of the Old Red Sandstone apparently were formed in great inland lakes not unlike the Lake Superior of to-day. Hugh Millar has made this formation famous by his charming book entitled, "The Old Red Sandstone." How strange in appearance the creatures which dwelt in these great lakes must have been, cannot be better described than in the words of Hugh Millar himself: "Creatures whose very type is lost, fantastic and uncouth, and which puzzle the naturalist to assign them even their class; boat-like animals, furnished with oars and a rudder; fish plated over, like the tortoise, above and below, with a strong armour of bone, and furnished with one rudder-like fin; other fish less equivocal in their form, but with the membranes of their fins thickly covered with scales; creatures bristling over with thorns; others glistening in an enamel coat as if beautifully japanned. All the forms testify of a remote antiquity—of a period whose fashions have passed away."

We now come to one of the most important and interesting geological periods in the Earth's history, the Carboniferous period, during which our coal-fields were forming. It was an age of luxuriant vegetation, in which the land was covered with vast forests of most extraordinary appearance, composed of giant tree-ferns, Club-mosses, and Horse-tails of majestic proportions, and great monkey-puzzle trees (*Araucarias*). From our British Coal strata no less than 130 species of ferns have been obtained, yet to-day there exist in the whole of Europe but some sixty-seven indigenous species. Of the giant Club-mosses, whose trunks frequently exceeded fifty feet in length, some forty species have been discovered. Their descendants, the Club-mosses of to-day, are most abundant in tropical climates, are diminutive in size, and usually creep on the ground, though a few, like the *Lycopodium densum* of New Zealand, stand erect and attain a height of nearly three feet. The Horse-tails (*Equisites* and *Calamites*), whose stems were five inches or more in diameter and eight feet in height, grew in dense companies on the sand or mud flats, in much the same manner as their dwarf descendants of to-day. In the sluggish rivers and swamps dwelt weird amphibious animals of predaceous character, ranging in size from a few inches to some eight feet. Fishes swarmed in the waters of the period; many were armed with powerful conical teeth, while others possessed massive palates adapted for crushing or cutting their food. In the estuaries vast numbers of a species of fresh-water mussel existed, their shells, somewhat resembling the form of their modern representatives. Lace-wing flies flitted through the dark



RHYNCHONELLA, FROM THE OOLITE FORMATION.

HOPLITES LAUTUS—A FOSSIL NAUTILUS FROM THE GAULT

glades, and were captured in the snares of strange spiders; while scorpions, centipedes, and leaf-insects crawled amongst the rank vegetation. Indeed, the Coal measures and Carboniferous Limestones abound with fossil remains, the oval nodules of hard clay which are found in the coal seams yielding a rich harvest of fossils.

The next most interesting formation to the amateur geologist is the Lias, which has yielded an enormous number of most important fossil remains, all in a wonderfully perfect state of preservation. It was an age of gigantic aquatic reptiles, the Ichthyosaurus and Plesiosaurus, creatures measuring from eighteen feet to thirty feet in length; of wonderful fishes, and countless mollusca. The ancestors of the modern Cuttle-fish and Octopus were exceedingly numerous, and their well-preserved fossil remains abound, more than 130 species of Ammonites and nine species of Nautilus having been found; indeed, the different zones of the Lias are characterised by particular Ammonites. Vast numbers of a species of oyster or Gryphæa are found in the Lower Lias, which is sometimes in consequence called Gryphite Limestone.

The Oolite and Purbeck beds afford a large number of most interesting fossils, for in the latter formation have been found the fossil remains of several species of warm-blooded marsupials. The plants of the Purbeck beds consist chiefly of ferns, conifers, and cycads, and all point to a tropical or semi-tropical climate, for the Araucarian pines which are now living in Australia and its islands, together with marsupial quadrupeds, are found in the same way to have accompanied the marsupials in Europe during the Oolitic period. The Oolites yield beautiful examples of the fossil "Stone Lilies" or Crinoids, which are not plants, but related to the Star-fishes. They are of very great interest, not only on account of their beauty, but also from the fact that though so numerous in past geological ages, the genera have gradually dwindled, until but a few members of this ancient family, like Pentacrinus and Comatula, survive in the seas of to-day.

The Upper and Lower Cretaceous, or chalk formations, include many remarkable fossil remains. The earliest fishes with internal bony skeletons occur in Cretaceous rocks, together with the Iguanodon, a gigantic reptile that walked on its hind legs, and the strange Pterodactylus, or Winged Lizard, which measured sixteen feet six inches from tip to tip of its outstretched wings.

F. MARTIN DUNCAN.

ENCRINITIC LIMESTONE COMPOSED OF THE STEMS OF STONE LILIES (ENCRINITES).

LEAVES AND FLOWERS OF BERBERRY.

HOW TO KNOW THE SHRUBS GROWING IN BRITAIN—V

With Notes, descriptive and photographic, for their Identification in all Seasons of the Year

By HENRY IRVING

THE JUNIPER THE BERBERRY THE TAMARISK

THE JUNIPER

THIS is a conifer. Though to a popular view its fruit would seem to be a berry, being neither conical in shape nor cone-like in structure, but, on the contrary, round and succulent, yet its true character is that of a cone. It is, however, the only cone of its kind.

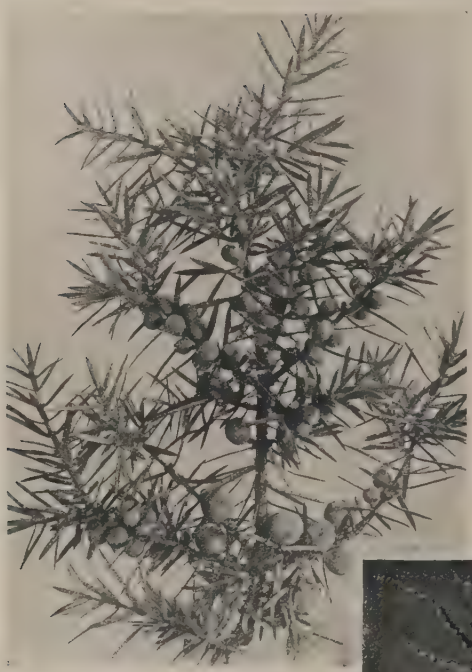
The habit of the Juniper shows considerable variation. It may be a small tree. It is usually a shrub, upright with ascending stems, or low and flattened with spreading and even prostrate branches. It has remarkable power of adaptation to varying conditions of position and altitude, soil and climate. With us, on the whole, it seems to prefer the dry, sunny, and open slopes of the chalk hills, where its scattered tufted bushes are frequently a marked feature. Lacking the spiked branches of the Gorse, it is, however, well protected against browsing animals by the abundance of its stiff and sharply spinous foliage. Its slender stems, irregularly but profusely branched and twigged, with close-set multitudinous evergreen leaves, make it an ideal shelter for numerous small birds at all seasons. The bluish or greyish green of its general aspect, very particularly noticeable in early

summer when the fresh shoots abound, affords a pleasant variation amongst the greens of Nature.

The bark is scaly, furrowed in age, and when peeling off hangs in ragged strips. That of the branches is reddish brown in colour, passing to greyish brown. The buds are very small, green, without protecting scales, being tiny tufts of young, pointed leaves. The leaves are long and narrow, boat-shaped, hollowed out above, keeled beneath, hard and rigid, with a sharp needle point at the prow. The edges and the under part are green, but the concave part above is lined with silvery wax, which serves to give to the whole shrub its characteristic tint. These leaves are arranged in groups of three, radiating from the twig in a single plane. Each group is separated from the preceding by only a small space of bare stem, and each group has its leaf insertions alternating with those before and after, so that the defensive points at the tips of the leaves are presented in turn in every direction. The leaves remain attached for about four years. In the winter they assume a reddish tinge.

The flower-clusters, each no larger than a very small bud, are inconspicuous. Those bearing pollen are, as a rule, on different shrubs from those which produce fruit. Both may be found in autumn near the middle of the current year's shoots, at the points of junction with the leaves. They do not open till the following spring. The pollen flower-clusters, mere conical groups of stamens, with diminutive scales and no petals, are yellowish. The fruiting flower-clusters, also without petals, are true cones, having overlapping scales. These are pale green in colour, and show at the tip three erect whitish points, indicating the parts which fructify. The fruit, a berry-like cone, takes two years to mature. It is at first green, but on ripening becomes a bluish black, coated with a waxy bloom. It is almost stalkless, being close down on the twig. What in ordinary cones are dry enclosing scales have here been converted into a succulent juicy casing, attractive to birds, which are the agents in the dispersal of the three enclosed seeds. Fruits in their two stages—those of the last and those of the present year—are

JUNIPER BUSH.



FRUITS OF JUNIPER.
Some in their first year, others in their second year of growth.

to be found on the shrub at the same time.

There is a dwarf variety of Juniper, which has shorter and less prickly leaves. This is found chiefly on the mountains of North Wales and of Westmorland, and in Scotland.

THE BERBERRY

This shrub, also known as Barberry, is a doubtful native. In a wild state it may be found in hedges, thickets, and open woods. It was much more common formerly than now, having been sedulously uprooted of late years because of the harbourage it gives to the fungus, in one of its life stages, which causes "rust" on wheat. It is an elegant shrub with numerous arched branches. In early summer these are adorned with ordered clusters of golden bell-shaped flowers. In the autumn there is a scarcely less beautiful array of brilliantly coloured fruits. It is effectively protected with spines.

The brown winter twigs are zigzag. At each bend in the zigzag is a blunt brown bud, and immediately beneath the base of the bud are usually three slender, stiff, sharp spines, two of which project to right and left, whilst the third points forward. These are frequently depressed, serving, not only for protection, but to some extent also as grapnels, giving support, like the prickles of a bramble, when pushing through other vegetation. These spines are modified leaves. The

FLOWERS OF TAMARISK.

leaves, tufted on the short shoots, scattered on the long shoots, are oval, pointed at the base and tip, rather stiff, edged with tiny but distinct spines. The midrib is well marked, but the secondaries are obscure, breaking up almost immediately into a decided network of smaller veins.

The flowers are complete with stamens and pistil. They have six petals and six calyx leaves, all of a rich golden yellow, forming a kind of double cup or bell. A very perfect device secures cross fertilisation by the agency of insect visitors. The six stamens, lying prone in the cup of the petals, radiate from the base of the central columnar pistil. These stamens at the base are highly sensitive. Here are the honey glands. An insect seeking the nectar inevitably touches a stamen, which instantly springs up, striking its pollen box against the visitor, whom it dusts with pollen. The insect, bee or beetle, may or may not be startled away. In either case it carries some pollen to the next flower visited, which goes through a like performance. So the pollen is conveyed from flower to flower.

The berries are long oval, or oblong; juicy, and of a bright orange-scarlet colour when ripe, attractive to birds. They contain two or three seeds.

THE TAMARISK

This is the shrub of the sandy wastes and the seashore. It has been naturalised here, and is found chiefly and in some abundance round our southern coasts. Growing under conditions which other shrubs are unable to endure, in sheer sand, drenched by sea mists or by driven salt spray, exposed to drying winds and the untempered sun-heat, yet thriving withal, it has been largely utilised to make hedges about the reclaimed shore lands, and for ornamentation on the seaside promenades. Its habit, whether as shrub or small tree, is loose and feathery. Its long, slender, withe-like branches give it some resemblance to a willow, but the leaf system reminds one rather of that of the cypress or the heath.

On old stems the bark becomes deeply fissured, and in colour is a yellowish brown. That on the branches is marked with fine lines, is red in colour, varying to purple or brown. The branches curve over at the ends. The leaves, which are minute, scale-like, of triangular shape, and grey-green in colour, entirely clothe the slender shoots, to which they are pressed closely, overlapping at the edges after the manner of tiles. Transpiration, as is very needful under the conditions

BERBERRY BUSH IN FRUIT

THE TAMARISK.

of growth, is accordingly reduced to a minimum.

The flowers, complete with stamens and pistil, are individually small. They have each five pink or whitish petals. They are densely grouped in long cylindrical clusters, occupying nearly the whole length of the slender lateral twigs on which they occur. As these floral twigs are themselves usually clustered towards the ends of the branches they become very conspicuous, resembling rosy feather plumes. Their colour is deepened by the red tips of the many prominent stamens, of which there are five in each small flower. The petals remain attached till the fruit is ripe. The fruiting clusters bear a striking resemblance to the fruiting catkins of a willow. Each fruit in the long fruit-cluster is a three-valved capsule, and contains several seeds. Each of these seeds is crowned with a plume of fine silky hairs serving in aid of its dispersal by the wind.

Very abundant on the sandy or marshy sea-coasts of the Mediterranean, and along the western shores of Spain, Portugal and France, its range with us is along the sea border from Cornwall to Suffolk. Though apparently often semi-wild, it was probably always planted in the first instance, its ready growth from cuttings affording facility for quick increase wherever required. This and several varieties are often found in gardens further inland, where their feathery branch sprays and rosy plumes of flowers make a distinctive and welcome addition to the shrubbery border.

HENRY IRVING.

EGG-CASES OF SOME COMMON FISH

By S. F. MAURICE DAUNCEY

With Photographs by A. F. DAUNCEY

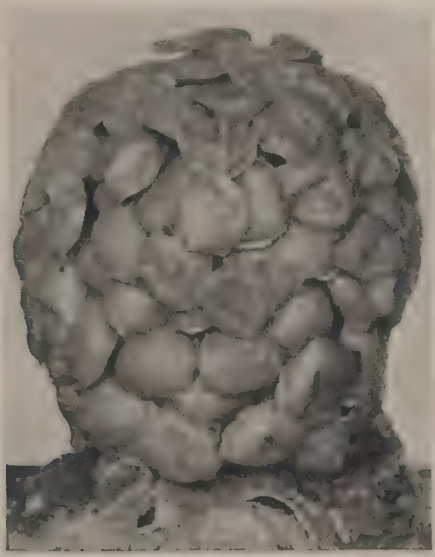
MOST people are acquainted with the eggs of the Cod—the Cod's roe—as they are seen at the fishmonger's during the early months of the year; but there are forms of fish eggs, or rather fish egg-cases, to be found on the beach, which perhaps the majority of seaside holiday-makers hardly recognise.

Almost at any season of the year we may pick up a light yellowish mass composed of small capsules which, at first sight, may be taken for a piece of coarse sponge. If it be found above high-water mark it will most likely be somewhat brittle; but if it have only just been washed up it will be very sponge-like to the touch. These little capsules are the egg-cases of the Whelk.

The spawning season is during the autumn, and each capsule, when extruded, contains some five hundred to six hundred eggs. As bunches of the capsules vary in size from a small apple to a melon, the number of eggs produced annually by one fish will be seen to be enormous. It probably runs into millions.

About half a dozen or so of the eggs in each capsule generally begin to develop before the rest, and these "young barbarians" at once start feeding on their less wideawake brothers and sisters. By means of this food the young fish is able to live within the egg-case, where it was hatched, until its shell is formed, and then during the spring it sallies forth to fare for itself.

SKATE'S EGG-CASE.



WHELK'S EGG-CASE.

"Jack Tar" is a resourceful man, and when soap fails him he will use these capsules to wash his hands with. They have accordingly been called "sea-wash balls."

Another common egg-case, though perhaps not so common as the Whelk's, is that of the Skate. This case is oblong in shape, and has a short arm at each corner. It is often found partly covered by seaweed and zoophytes.

The name "Skate's barrow" has been attached to this case, owing to the resemblance it bears to a hand-barrow. When picked up in the summer it is, as a rule, empty, or only filled with sand and small pebbles. If examined, one end will be found to be broken open, and it was through this crack that the little Skate got away.

DOG-FISH EGG-CASE.

The egg-case of the Dog-fish is not such a common object, and the reason is that it is provided with very long and elastic tendrils—if we may borrow a botanist's word. These readily fasten on to seaweeds and other objects, and once so moored the case cannot easily be washed away. The material of which it is made is of a horny nature, and, when dry, if it is tapped with the nail it gives very much the same sound as does a hollow horn.

The case is constructed so that the end nearest the fish's head will open upon the slightest pressure from within; and, being of an elastic material, will at once close again when the fish has passed out.

BIRD LIFE OF THE LEIGH WOODS, SOMERSET

By HEDLEY VICARS WEBB

With Photographs by R. PRATCHETT, Bristol

THE Gateway of the West seems an appropriate name for that wonderful canvas of Nature, the Avon Gorge and Leigh Woods, which has made Clifton so famous, and attracted lovers of the beautiful from all parts of the country. The spring of 1909 has seen an added interest taken in this unrivalled demesne of Nature, for by the generosity of a member of the house of Wills, the woods clothing the Avon Gorge on the Somersetshire side have been secured to the citizens of the Metropolis of the West and their descendants for all time. The glory of May-time is rapidly passing into the leafiness of June as we cross the Suspension Bridge and reach the roadway skirting the edge of the cliffs, with the Nightingale Valley two hundred feet below. To look "down" on the tree-tops is an experience not always obtainable, but how beautiful is here the effect, with oak, ash, birch, larch, fir, wych elm, white beam, spindle, sycamore, etc.,

BIRD LIFE

TYPES OF BIRDS

Birds of Prey

Although there is little opportunity of studying the members of this class of birds in their natural state, yet they present most interesting material for lessons on bird life, especially in reference to their highly adaptive features. Stuffed specimens, where obtainable, are valuable aids, yet in most instances the teacher must resort to pictures and photographs.

The chief birds of prey are the Eagles, Hawks, and Owls. In each example the points to be noticed are :—(*a*) Strength of beak and claws ; (*b*) keen vision ; (*c*) rapidity of movement. In the case of the Owls the most interesting points are :—(*a*) Nocturnal habits, and (*b*) noiseless flight.

The Sparrow Hawk is a widely distributed bird, and may be observed in many districts.

Perchers

These embrace a large number of birds, and there are numerous examples in every district. Their claws are especially adapted to grasping branches. Our finest singing birds are found among these types. Useful examples for study are the Woodpecker, Thrush, Tits, and Finches. The nests of the last three are beautifully constructed.

EAGLE

BIRD OF PREY

WOODPECKER

PERCHER

in the full glory of reawakened spring! The neighbouring church of St. Mary's is the centre of a fairyland of natural beauty, when the silver birches in thousands are putting on their graceful foliage, and not even the magic wand of an Oberon or Titania could produce anything more charming. What more fitting home could be found for our native songsters, now joined by a numerous company of warblers from over the seas? From dawn to sunset the woods resound with their songs. The cheery little Chiffchaff sings unceasingly from the tree-tops, where he is busy searching for insects; while his cousin, the Willow Wren, is equally active in the same pursuit. Another relation, the Wood Wren, is not far off.

These three diminutive migrants are the very life and soul of the woods, for they are always busy, always happy, and always singing; and their light and graceful movements are fascinating to watch. Being so closely allied in size and olive-green plumage, they are somewhat difficult to distinguish, except by an expert observer. The song, however, is distinct in each case. The notes of the Chiffchaff form a constantly repeated strain of "chiff, chaff, cheep, cheep, chap," the musical tone of which readily distinguishes the song from the metallic "see-saw" notes of the Great Tit. The Willow Wren fully deserves to be known as the "canary of the woods," its song consisting of a series of liquid, rippling notes, chiefly of a descending scale order. To an attentive listener it appears that each bird varies his phrases not a little, but all have the characteristic tone. A beautiful effect is sometimes heard when several Willow Wrens are in song at the same spot. Each bird will commence its song immediately after a rival, and the rapid succession of their descending strains produces a kind of "chiming" most pleasing to hear.

The most noticeable feature of the Wood Wren's song is that it begins slowly with a "chit, chit, chit," and only a slight raising of the pitch, and then gradually

THE VALLEY OF BIRD LAND.

A FAVOURITE HAUNT OF THE NIGHTJAR

quickens until at the close the notes are lost in an ecstasy of confused chattering, the body of the singer shivering with the movement.

It is somewhat unfortunate that the woods only contain one small pond, and this, situated close to the roadside, has been included in the purchased portion of the estate. A pond or pool is always a favourable spot for observing bird-life, so standing here, perfectly still and partially hidden, we watch for arrivals, who come to drink or bathe. Twenty species or more can frequently be counted in the space of half an hour. From the bushes and trees they drop quietly to the edge of the water — the handsome Redstart, the wary Nightingale, the Blackcap, the Garden Warbler, the Great and Blue Tits, the graceful Long-tailed Tit, the Chiffchaff, Willow and Wood Wrens, the irrepressible Robin, the boisterous Blackbird, the cautious Thrush, dusky Hedge Sparrow, sprightly Chaffinch and Jenny Wren.

No bird-lover can possibly be contented till he has made the acquaintance of the Nightingale and its song; and the Leigh Woods give such an opportunity during May and the early part of June, for this peerless songster loves the seclusion of the bush foliage. The bird does not, however, resent observation if you remain quiet and still. Its presence is soon discovered by hearing a very rapid "wheet, wheet, wheet" frequently repeated, and these notes are so arresting that they at once command the attention of a listener. Snatches of song then generally follow. The full song is sometimes to be heard at midday, when the sun is bright and warm; but late in the evening twilight, when other songsters are silent, is the time for hearing the marvellous melodies to perfection. Beautiful as the song of Philomel is, it is not wholly melodious. Many of the strains are composed of a sometimes toneless, sometimes harsh repetition. A simple note uttered very rapidly will be continued for two or three seconds. The

THE BRIDGE VALLEY ROAD IN THE AVON GORGE.

next strain may be a rather fierce-sounding "r-r-r-r," ending abruptly, to be followed by a phrase exactly resembling a Blackbird's rattling alarm, but having a better tone. There is one feature, however, which raises the character of the song above all others, and that is the magnificent crescendo. This is particularly noticeable in the strains composed of long notes.

The male Redstart is one of the most handsome of our spring visitors, his white forehead, black head and cheeks, contrasting well with the slaty blue of the back and chestnut of the breast. The fiery tail is at once seen when he flies off. He and his more sober-coloured spouse are very partial to the oak tree, in a hole of which may be found the nest.

From the top of a hawthorn the Blackcap pours forth its beautiful song. This warbler is considered by some a Nightingale secundus. The male bird is recognised by its black head and slaty plumage. The female has a brown cap. The rapid variations in pitch of the Blackcap's song are remarkable, high notes and low notes and medium ones being taken with such quick alternation that the ear can hardly follow. The singer is rather shy, and often darts off when observed.

Though perhaps a less common bird in the woods than the Blackcap, the song of the Garden Warbler closely resembles that of its relative. The songster itself is also of similar plumage, but without any distinguishing cap. The pitch of the Garden Warbler's full notes is often very low for so small a bird, and equals the lowest notes of the Blackbird.

An unobtrusive little bird is our dusky friend, the Hedge-sparrow, or Accentor. Being a soft-billed bird, and therefore not a real sparrow, he fully deserves more attention than he usually gets, for his song, though short, is a sprightly little warble, rapid and with numerous turns. Its nest is always a happy find; the beautiful blue eggs seem to reflect the azure of the sky, and contrast charmingly

WHERE THE WILLOW WRENS WARBLE.

with the green foliage surrounding the nest.

The Tit family is well represented in the woods. The Great Tit is constantly uttering his "see-saw" strain, and is easily distinguished by his size. The Blue and Cole Tits are as tiny and active as mice among the branches. The former can be recognised by the prevailing blue colour, and it has a narrow dark streak down the middle of the breast. The Cole Tit is of a much duller plumage, and has a small white spot on the nape of the neck. The Long-tailed Tit is the most delightful of all the species, and can be readily known by its tiny body and very long tail. The general colour at a distance is black and white, but at closer quarters a rosy colour is seen on the back and flanks. Very fortunate are we when the nest is discovered. It is one of the marvels of bird architecture, generally placed in a thorn bush, dome-like in shape, and completely closed except for the small entrance hole near the top. The interior is lined with myriads of tiny feathers.

WHERE PHILOMEL SINGS.

The smallest of European birds, the Golden-crested Wren, though not uncommon in the woods, may easily escape notice, as it haunts the tops of trees, preferring firs and larches, where it diligently searches for its insect food. In plumage it is of a yellowish olive-green, with the golden crest on the head.

The Nuthatch and Tree-creeper haunt the Nightingale Valley all the year round. The former is a most cheery little fellow, always busy, and always happy. He climbs up or down the trunks of trees with equal facility, and you may hear and see him in the fall of the year, hammering away at a nut which he has placed in a crevice of the bark of a tree. Just now he is as busy as a mason, plastering up with mud the entrance hole to his nest, until it meets with his approval as to size and security for his family. The Nuthatch has a few song cries, all of which are loud and distinct. One of these is a clear whistle, slurred upward in the inter-

val of about a sixth—just such a whistle as one would give to call a dog.

No less interesting is the silent Tree-creeper as he climbs the boles spirally, searching unerringly every tiny hole for insects, and giving one the opportunity of noting his dark brown back with pale spots, and the silvery under-parts.

The Finch genus is fairly numerous. A short full whistle reveals the presence of the handsome Bullfinch, which can also be recognised by its heavy lilting flight, and the conspicuous white patch over the tail. The song consists of little more than the whistle given on two or three notes. The Greenfinch has now put on its brightest attire of yellow and green, and the somewhat coarse "wheeze" which ends its song is heard almost incessantly from all parts of the woods. The Chaffinch is more numerous than its relative, and the familiar song, together with the well-known call-notes "pink, pink," meet one at every turn.

That most interesting nocturnal bird, the Nightjar, finds a good retreat in the woods, for bracken abounds, where he delights to hide during the day. If flushed by anyone, he simply flies a short distance and drops again into the undergrowth. He is sometimes discovered lying "along" a branch of a tree, a method of perching peculiar to himself, which serves admirably to hide his identity from the branch itself. At dusk he throws off his lethargy, and becomes extremely active in his pursuit of moths, etc.

The twofold shout of the Cuckoo is often heard in the woods, although this visitant prefers more open country, flying from tree to tree and frequently "calling" for a mate when doing so.

Woodpeckers and Jays can always be seen or heard. By stalking the laughing call of the Green Woodpecker, you may get a peep at him as he ascends a tree. The Great Spotted Woodpecker also makes his home here, nesting regularly in the woods.

Gulls and Jackdaws are inseparably associated with the Avon Gorge. Nearly all the former belong to the Black-headed species. They are frequently to be seen in large companies at low tide, walking over the muddy banks and showing plainly their red legs and beautiful plumage. At other times they swim on the water as gracefully as ducks. Sometimes, too, they rise together high up over the Gorge, carrying out very remarkable evolutions of a circling nature and never colliding one with the other. The Daws are seen all the year round, flying to and from the inaccessible rocks on the Clifton side, where they nest, happily and unmolested, in the springtime.

That graceful and useful bird of prey, the Kestrel, is occasionally seen hovering over the Gorge, giving an opportune moment for looking "down" on his mottled brown plumage as he rises and falls below you. The quivering wings, the inclined head and fan-like tail cannot fail to arrest the attention, and you watch every movement until the Wind-hover returns to the woods. I here wish to urge an earnest plea for the Kestrel and other useful birds of prey. Nature has herself provided these Arabs of the air, and it is to man's advantage that this provision should be respected. Yet how frequently are both Kestrel and Owl—the very best possible friends of farmer and agriculturist — relentlessly trapped and shot for their pains in keeping down vermin!

Retracing our steps from this ramble in Nature's domain, we linger by the edge of the cliffs near the bridge to enjoy the scene on the Clifton side of the Gorge. A remarkable wealth of arboreal foliage clothes the slopes of the Bridge Valley Road. You listen to the Thrush and Blackbird engaged in a vocal contest for the mastery until the Nightingale defiantly breaks in upon them. The Cuckoo continues to "call" and the Nightjar commences his persistent "churring." Willow Wrens warble unceasingly, and nothing seems to repress the trill of the Robin. The Gorge has become shrouded in a mantle of blue. A spring tide fills the Avon. The last Gull is going homewards to the Severn Sea. Later a full moon will rise upon this wondrous scene. Here and now will the Nature lover realise, if he has not already done so, that the old City of the West possesses a fairyland of natural beauty, pulsating with life, and rich in the mystical music of springtime.

H. Vicars Webb.

OLD OAK TREES.

From a Water-Colour Drawing by C. E. Flower.

EGGS OF THE MAGPIE MOTH.
(Magnified 20 diameters.)

THE MAGPIE MOTH AND ITS PARASITES

By JOHN J. WARD, F.E.S.

Author of "Life Histories of Familiar Plants," "Some Nature Biographies," "Minute Marvels of Nature," etc

Illustrated from Original Photographs by the Author

AMONGST those insects that work mischief in the gardens and fruit farms, the Magpie, Currant, or Gooseberry Moth (*Abraxas grossulariata*), as it is variously called, holds a very prominent place. The British Board of Agriculture have, indeed, found it necessary to issue a leaflet giving methods of prevention from, and remedies for, the attacks of this destructive insect.

The moth appears about midsummer, and it frequently flies during daylight. Its wings are white, bearing numerous deep brown or black spots and blotches, together with some yellow markings; consequently, it is a very conspicuous insect. It derives its popular name, Magpie Moth, from the bold markings of its wings, while its other familiar names have reference to the plants upon which it works so much havoc during its larval period.

Some of the eggs of the moth are shown in the first illustration magnified twenty diameters. They are somewhat oval in shape, and their shell structure bears a silvery appearance and is beautifully reticulated with a delicate pattern, which is revealed by means of a magnifying lens, as the illustration shows. Although the tiny eggs have so attractive an appearance under the lens, it is, nevertheless, from these little objects that the fruit-

grower's trouble arises. When the female moth has once deposited her numerous eggs amongst the leaves of gooseberry or currant bushes, it becomes a difficult task indeed to prevent the foliage of the bushes from being more or less completely stripped later on.

In ten or eleven days after the eggs are deposited, the little caterpillars emerge, and at this stage are so small that they escape notice. Their feeding at this period does but little harm, and towards the end of August, or early in September, they give up feeding and spin bits of leaves together on the ground beneath the bushes. Later, falling leaves afford them further protection, and so they spend the winter months.

The fruit-grower has probably failed to observe the advent of his enemy, but it is in the following spring that he detects the mischief that is being done to his trees. Just when the branches are becoming clothed with new leafage, numerous dark-coloured caterpillars may be seen biting out the hearts of the buds, and should these destructive larvæ be neglected at this stage, the branches will often be completely denuded of their leaves, and the fruit crop for that season ruined.

So ravenously do the caterpillars feed after their winter hibernation that often by the first week in May they are full-fed. Some full-grown larvæ are shown on p. 1107. They are of a cream colour, striped along the sides of their bodies with orange-yellow, and bearing large black spots along the back. Indeed, they are coloured very similarly to the moth which they eventually become.

Now these contrasting and conspicuous colours play a very important part in the economy of this insect. Both the moth and the caterpillar make no attempt at concealment, but expose themselves boldly before their enemies; they rely entirely on their gay and conspicuous colouring to warn off their foes. While many insect species depend for protection upon a more or less perfect simulation of their surroundings, whereby they become inconspicuous, the Magpie Moth, throughout all the stages in its development, takes the contrary course, and flaunts its colours before the eyes of its enemies, thus making itself as conspicuous as possible.

THE ICHNEUMON FLY SEEKING FOR CATERPILLAR VICTIMS ON WHICH TO DEPOSIT ITS EGGS.

Such showy colours are generally associated with nauseous and distasteful properties, and insectivorous animals are consequently warned from making an attack upon species so coloured. A frog or a toad, seeing one of these caterpillars in motion, may snap it up greedily, but will quickly reject it again, and nothing will thereafter persuade the frog or toad to touch another similar larva. Probably that first attack was wholly the outcome of inexperience.

This caterpillar is also distasteful to birds, spiders, and other enemies, and being thus enabled to escape from the attacks of some of the most formidable foes that prey upon caterpillar species, it naturally thrives apace and often becomes a serious pest, owing to its destructive work while feeding.

It happens, however, that when-

ever an organism outstrips its natural foes, and becomes too dominant in the struggle for existence, new enemies arise to check its ravages and restore the lost balance of power. So it occurs that, although in some seasons we may find the leaves of currant, gooseberry, or plum trees being destroyed by innumerable larvæ of the Magpie Moth, it does not follow that there will be numerous moths later in the season, and that the pest will thrive and become still more abundant the following season. Probably by the time the moths should have developed, Nature will have taken measures to correct the defect in her working scheme that has allowed an organism too decided preponderance, and will have checked it so thoroughly that, during the season that follows, the predominant species may become quite scarce. We will now, then, observe how any excessive development of the Magpie Moth is suppressed.

FULL GROWN CATERPILLARS OF THE MAGPIE MOTH AMONGST GOOSEBERRY BRANCHES.

Last autumn in the writer's garden some gooseberry bushes were badly attacked by the larvæ of the Magpie Moth, and the caterpillars fed boldly in the bright sunlight, in their characteristic manner. Now, one could not approach these bushes during sunlight without finding swarms of what were apparently common house-flies buzzing round and congregating about the branches and amongst the leaves. This fact led to an experiment.

Some of the full-fed caterpillars were collected up and provided with some dried stems on which to form their cocoons. In the upper part of p. 1108 two of the larvæ are shown in their delicate silken cocoons, in which, when they have moulted their skins, they change to the pupa or chrysalis stage; while below, on the right, another has completed its change into a chrysalis, its shrunken caterpillar skin being seen near it. In the lower part of the photograph on the left is seen another cocoon in which appears the shrunken skin of a caterpillar and three comparatively small chrysalides of oval form.

The chrysalis of this moth is banded black and yellow, and probably, like both the caterpillar and the moth, it derives protection from its bold colouring; indeed, the very frail character of the cocoon, in which the chrysalis is clearly exposed to view, points to that conclusion.

ABOVE ARE TWO CATERPILLARS ALMOST READY TO BECOME CHRYSALIDES. BELOW, ON THE RIGHT, IS THE COMPLETED CHRYSALIS. ON THE LEFT APPEAR THREE CHRYSALIDES OF THE PARASITIC TACHINA FLY.

In favourable weather, at the end of from three to four weeks, the moth is ready to appear, bursting its chrysalis skin and the silken threads of its cocoon, and appearing upon the branches to shake out the folds from its wings (p. 1109). It does not follow, however, that such a successful issue always takes place, as the experiment previously referred to made clear.

It was obvious that something was amiss in the cocoon in which the three small pupæ appeared. In several other examples under observation the same thing occurred, and, after seventeen or eighteen days, from each of these little chrysalides there emerged what appeared to be a common house-fly. A closer glance at these insects revealed the fact that although they closely resembled house-flies, yet they were really only near relatives of those familiar insects: a species, indeed, whose habits are very different.

These flies belong to the family *Tachinidæ*, and are commonly referred to as Tachina flies. There are numerous species, most of which in general appearance resemble house-flies, or blow-flies. To man they are most beneficial, as in the larva stage they prey largely upon caterpillars which feed upon his crops.

Whenever a gooseberry, currant, sloe, or other bush, on which numerous caterpillars are seen to be feeding, is surrounded by a buzzing swarm of flies, some of which are continually alighting and moving amongst the leaves, it will be found that these are Tachina flies. Their function is to seek out plump-bodied caterpillars, and, by means of a gummy substance, to fasten their eggs to the skins of the larvæ. From

THE PARASITIC ICHNEUMON FLY SEEKING FOR CATERPILLARS.

the egg there hatches a small maggot which penetrates the skin of the caterpillar, and feeds internally on that insect until its development is complete. The larva develops a ravenous appetite, but the nourishment that it absorbs all goes to benefit its internal boarders. Finally, when the caterpillar should change into a chrysalis, it usually has about sufficient strength left to construct its cocoon, which is the closing scene of its life. The parasites within then consume the vital parts of their host, and this final meal usually suffices to complete their development, whereupon they break through the skin of the caterpillar that has reared them, and quickly change into pupæ with the silken cocoon, as shown in the lower example on the left of p. 1108.

THE MAGPIE MOTH JUST EMERGED FROM ITS CHRYSALIS.

Not infrequently amongst the bushes where Tachina flies are abundant the parasitic Ichneumon flies will also be found. These are hymenopterous insects, possessing, like wasps and bees, two pairs of wings, a feature which readily distinguishes them from the dipterous, or two-winged, Tachina flies. The Ichneumon flies may be recognised by their active movements amongst the leaves, their long antennæ continually twitching and quivering with excitement as it were, while they seek for caterpillar victims on which to deposit their eggs; for although they belong to an entirely different group of insects to that of the Tachina flies, yet their method of attacking leaf-eating caterpillars for egg-depositing purposes, and the subsequent development of the larvæ, is very similar.

The Ichneumon flies, however, have probably attained a much higher evolution than the Tachina flies, for the latter will attack caterpillars of various species indiscriminately, and also the larvæ of beetles, humble-bees, wasps, and insects of other orders; and not infrequently they deposit more eggs on a larva than its substance will provide for their maggots; or they will even place their eggs on a caterpillar that is about to moult its skin, with the result that the young grubs perish when hatched from the eggs.

The more highly evolved Ichneumon flies, however, rarely make such errors; indeed, a particular genus or species of these parasites will sometimes prey upon only a certain family of insects, so that a caterpillar may have its special Ichneumon; or, if it is an abundant species, it may have several kinds of Ichneumons, which patronise it as their special host for the rearing of their young.

From some of the pupæ of the Magpie Moth under observation in the experiment previously referred to, the Ichneumon species illustrated on pp. 1106 and 1108 emerged, one fly only from each moth pupa. The slender curved waist attached to the lower part of the thorax, the long and pointed antennæ, and the fore-wings bearing a dark-coloured triangular spot, are all features which show well on p. 1106, and which should be observed by all amateur entomologists desirous of distinguishing these insects.

When one has realised the significance of the persistent attacks of these parasites combined with those of the Tachina flies, it becomes plain that the larvæ of the Magpie Moth, although protected by their colours from many dangerous foes, have yet even more formidable ones to contend with on which their warning colours exert no influence. So it happens that a mighty host of leaf-eating larvæ may quickly become converted into winged Ichneumon and Tachina flies instead of moths; then it may occur that Ichneumon or Tachina flies are in excess, and then their enemies in turn appear in abundance. Thus the balance of power in Nature ever needs and receives readjustment.

JOHN J. WARD.

THE COLE TIT

By ALFRED BRAILSFORD

With Photographs by the Author

OF all our feathered neighbours who make their homes in our woods and gardens the family of Titmice are, perhaps, the most fascinating. With their knowing looks and pretty colouring, not to mention the business-like way they have of looking for their food, they afford endless pleasure.

The smallest member of this family, the Cole Tit, feeds chiefly on insects, but may be coaxed into our gardens in the winter by means of a suspended Brazil nut, almond, cocoanut or piece of fat. A bird will come near, perch on the suspending string, hop to the top and bottom rims of a cocoanut—the end of which has been sawn off—twisting and turning himself upside down, right way up or sideways, and performing gymnastic exercises and balancing feats which any variety entertainer might be envious of.

THE COLE TIT.

All the Tits may be attracted by these means in the winter, but as spring draws near their visits become less frequent, and in the middle of April they cease, when the birds betake themselves to the woods and orchards to rear their hungry families.

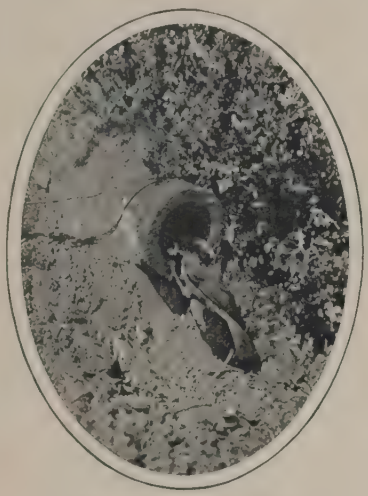
The Cole Tit likes various kinds of holes for breeding purposes. Small drain pipes, rat or mouse holes in banks, holes in trees and stone walls, are all used in turn, and in these the pair of birds build their nest of dried grass and moss, neatly lined with a soft layer of feathers. On this downy bed the hen lays from six to ten beautiful little eggs speckled all over—more thickly at the larger end—with rusty red spots.

After about ten days from the laying

of the first egg, the hen will be sitting. The cock is now all hurry and bustle, turning somersaults round the twigs of a neighbouring oak, peering into all the crannies for hidden treasure, taking his burden to his sitting mate, and receiving many kind acknowledgments.

The young are soon hatched, and the cock has to redouble his efforts, for he has not only to feed his mate but six or seven hungry youngsters. This lasts only a day or two, however, when he is joined by his mate. As the young grow the parents increase their exertions, and there are always open beaks asking for more!

When they happen to be near the nest together the hen will shuffle her wings and ask her mate in the plainest way for the delicacies he has brought.



ENTRANCE TO THE NEST.

Earlier in the year he would have taken notice of these appeals—or rather, would have been so assiduous in his attentions that the appeals need not have been made—but now he takes no notice, his extra duties absorbing his time and attention.

They bring from four to six caterpillars about every two minutes to the nest.

Let us say they work ten hours in the day and bring five caterpillars each time, we get some idea of the huge quantity the young consume. Multiply this by about thirty days and by the number of broods reared by all the insect-eating birds, and one may then imagine the enormous good done by them. How grateful our farmers and gardeners ought to be!

After a time the young become fledged, and leave the nest to follow their parents into the world of wood and sunshine, quivering their wings when food is brought, and twittering a grateful thanks in return. Later they become grown birds, independent of their father and mother, performing acrobatics in the topmost twigs on their own account, and will, no doubt, come to our cocoanuts and almonds in due season.

There is some confusion between the Cole Tit and his near cousin the Marsh Tit, and it would be well to mention here that the Cole Tit has white-barred wings and a white nape, whereas the Marsh Tit has neither of these marks.

ALFRED BRAILSFORD.

COMMON GORSE.

HOW TO KNOW THE SHRUBS GROWING IN BRITAIN—VI

With Notes, descriptive and photographic, for their Identification in all Seasons of the Year

By HENRY IRVING

THE GORSE AND THE BROOM

AS do the Laburnum and the so-called Acacia, the Gorse and the Broom both belong to the Pea-flower or Pea-pod tribe. In both the leaves as such occupy a very subordinate position, being either, as in the Gorse, converted to other forms and uses, or, as in the Broom, to a considerable extent suppressed. Yet the plants show more or less green the whole year round, so that they may roughly be classed among the evergreens. The flowers, which are a golden yellow of varying depth, have five petals, the arrangement of which may be best seen in those of the Broom. At the back is a single erect petal, the standard; next are two petals placed horizontally with their inner edges almost in contact, the wings; and beneath these two others joined above and below along their whole length, forming a closed boat-like structure, the keel, which encloses the vital

SEED PODS OF COMMON GORSE.

organs. There are ten stamens and a single pistil.

THE GORSE

Other common names are Furze and Whin. We have two varieties—a larger, the Common Gorse, which may grow to a height of eight or ten feet, and the Dwarf Gorse, rarely exceeding two feet. There is also a small allied plant commonly known as the Petty Whin, which, however, is not a Gorse but a Genista. This, at first glance, is so like the Dwarf Gorse that some description of it will be given and points of distinction noted.

The sentiment that kissing is in season during all those months when the Gorse is in bloom, points to the fact that some flowers of Gorse may be found in nearly every month of the year. Yet this is based on somewhat of a misconception. The Common Gorse may come into flower in November, showing odd spikes of bloom all the winter through, but the full blossoming time is in February or March onwards to the end of May or early in June.

During the following months all the brilliance of the Gorse is absent, only the fresh green of the new growing shoots changing gradually into the sombre tint

PETTY WHIN, SHOWING FLOWERS, PODS, LEAVES AND THORNS.

BROOM.

leaflets. The early leaves of the seedling are of this form, though these are immediately succeeded by simple ones, narrow, gradually stiffening into spines. On the mature plant, apart from these spines, no vestige of a leaf remains larger than a minute scale.

In the course of its evolution the Gorse has adapted itself to the endurance of excess of heat and drought. Its compound leaves have been changed to simple ones; these have narrowed to the spinous form, reducing evaporation to a minimum. So the Gorse is able to grow and flourish on the dry heath, exposed to the full glare of the sun. Here another necessity has arisen, that of protection against browsing animals. So these narrow leaves have hardened into spines, stiff and sharply pointed as a shoemaker's awl. Every projecting twig also has become pointed, itself a true thorn, ringed round with outstanding spines, sharp and strong. So the Gorse is armed cap-à-pie, leaving no part defenceless. Yet these hardened spines and thorns are directly due to the condition of dryness wherein the Gorse now flourishes. If seedlings be grown in a continuous moist air, as under a hand-glass, it will be found that, though in the first year, through sheer force of habit, a few shortened spines will appear, yet in succeeding years, so long as the state of moisture is maintained, there will be none—only soft, fleshy leaves. As is often the case with plants adapted to withstand drought, every part of the Gorse is densely coated with minute hairs forming a velvety pile. Twigs and branches are furrowed, and, like the spines, are green in colour.

The flowers grow singly or in pairs at

of the hardened spines, amongst which are the rather untidy-looking clusters of pods in their brown calyx-sheaths, darkening as they ripen. But in June, and it may be in July, the Petty Whin is in bloom, bridging the space of intervening time till the Dwarf Gorse is able to take up the tradition. Then the bright gold gleams beside the purple heather bloom, affording one of the most effective of Nature's contrasts, and, incidentally, justifying the faith of lovers in the truth and fitness of their ancient saw.

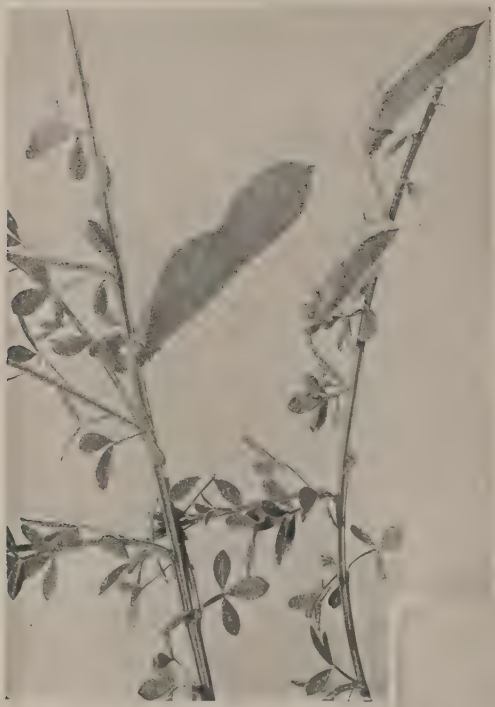
The Gorse practically has no leaves; these, as already mentioned, have been converted to other forms and uses. There is evidence that the ancestral form of leafage was that of the trefoil, a compound leaf consisting of three distinct

the junction of the spines with the thorn-twigs, and, being somewhat crowded together in the upper part of the branches, they form handsome spike-like clusters. The colour of the petals is a golden yellow, of the calyx yellow also, but modified by its dense coating of greenish or brownish hairs. The calyx, not quite so long as the petals, is divided to the base having the appearance of being jointed like a bivalve shell, opened to contain the flower. As the pod forms the petals shrivel, whilst the two halves of the calyx change to brown. The pod, which is only a little longer than the calyx, is also densely coated with hairs, grey-green changing to brown. It contains about five olive-coloured seeds, hard and polished. These by the drying and sudden splitting and twisting of the pod, accompanied by a sharp report as from a miniature pistol, are thrown far.

The *Dwarf Gorse* may be regarded as merely a reduced variety of the Common Gorse, though its season of flowering is in late summer and autumn. Its thorns are smaller and more slender. Its flowers are smaller and of a richer golden yellow, best seen and most effective in contrast with the associated heather purple. The calyx, equal in length to the petals, is all but hairless. Spines, thorns and stems are velvety and green, like those of the Common Gorse.

The *Petty Whin*, also known as the Needle Greenweed or Needle Genista, has very much the habit of the Dwarf Gorse, but its branches are more straggling. It grows also in similar situations, on dry heaths or moors. It flowers in June, and, occasionally, again in August or September. It has narrow lance-shaped leaves, but those on the flowering shoots are broader. It is entirely free from hairs on the leaves and stems. It has true thorns, but these do not branch as a rule. They are found mainly on the upper part of the stems, and are fine and sharp as needles. They are bent slightly backwards, perhaps with a view to securing better support amongst neighbouring growths. Thorns and stems are brown. The flowers in appearance are more like those of the Broom, though much smaller, displaying plainly the arrangement of the petals as standard, wings and keel. The petals are yellow. The calyx is green and hairless, is only about one-third the length of the petals, and is deeply divided into two parts, the upper part being again divided showing two teeth, and the lower part also showing three teeth. The hairless pods are broad and inflated;

DWARF GORSE.



SEED PODS OF BROOM (IMMATURE).

the persistent calyx, in comparison, is minute.

This is one of the class of plants that as *planta genista* gave to our Plantagenets their emblem and cognomen.

THE BROOM

This besom-like shrub is found generally in rather dry and waste places. It is a frequent inhabitant of steep railway banks, making there a brilliant display in its season of flowering. It has stiff ascending green stems and branches, ribbed and wiry, but there are only a few leaves. The lower leaves are usually compound, having three leaflets, and are attached by short stalks; those higher up are often simple, more lance-shaped, and without stalks. On some branches the leaves are reduced to mere scales, or are obsolete. The green stems have, in part, taken over the function of the leaves. The flowers, solitary or in pairs, grow out near the ends of the long shoots, where they are combined into long clusters. Their butterfly-winged petals of bright yellow render them very conspicuous. Like those of the Gorse, they secrete no nectar, but supply an abundance of pollen, which is eagerly collected by bees.

By an ingenious contrivance, whilst the bee is filling its pollen baskets from the five short stamens placed centrally in the keel petals, a slight explosion takes place. The long pistil shoots out from the tip of the keel, like a piece of released watchspring, and rubs its stigma over the bee's back. Nearly at the same instant,

FLOWERS OF BROOM.
Three of the flowers have exploded.

but just after, the five long stamens follow suit, dusting their pollen on the same spot. So the bee carries away more pollen than it knows of, some of which is taken up by a similar action of the pistil of the next flower visited, and cross fertilisation is achieved. After the explosion, which ruptures the flower, the petals do not recover their position, but leave the remainder of the pollen exposed, free to any kind of insect that may come for it. But no bee will ever take the slightest notice of a ruptured flower. The pods of the Broom are flat, compressed, and fringed along either edge with hairs. They contain several seeds which, when ripe, are flung out by the sudden splitting and twisting of the pod.

HENRY IRVING.

NATURE "IN TOWN"

CITY TREES

By ARTHUR SCAMMELL

THE writing of an essay on the subject of Nature in London would seem, at first sight, an example of the art of making bricks without straw, for, be it noted, the City proper, the "square mile," is our field, and we may not even step over the border into Gray's Inn to visit London's only rookery, nor go into the Embankment gardens to hear the thrush which sings there within the shadow of the Hotel Cecil.

And yet, though we have pushed Nature somewhat out of our sight, she is with us all the time; the rain falls in our streets, and the snow; and, in St. Paul's Churchyard, at any rate, it is possible to feel the force of the wind; half the day the fresh water flows down from the hills through our City, and half the day the sea water pushes it back; and everywhere the air, with patient unseen hand, is hiding seeds and germs innumerable, bidding them lie till time and chance bring the hour for life and growth.

Myriads perish and are swept away, but to some the hour comes; let a cistern leak upon a paving-stone in a back yard, and soon the stone will be green with moss. Pull down a house in the winter, and by next autumn the ruins will have become a garden; so quickly does vegetation spring, and so rankly does it grow, one may, casting the thoughts forward, imagine this "hot huddle of humanity" succeeded by a dense jungle, and see Lord Macaulay's New Zealander hewing his way with an axe to his seat on the ruins of London Bridge.

For centuries after its foundation there were probably pastures within London's walls on the north side, whereon cattle might be grazed in times of siege; and when, in mediæval ages, the monastic orders, the nobles, and other wealthy founders set up their establishments, the new buildings were always surrounded by large and fertile gardens.

And as long as London houses were the homes of Englishmen, the gardens remained; but minds seem now to be arranged in watertight compartments, so that the man who cannot dine or sleep unless surrounded, or at least backed, by his own "grounds," cheerfully passes most of the daylight hours of his life in a wilderness of asphalte and massed buildings.

However, the birds of passage in their flight over the City may yet look down upon a green islet here and there in the

Photograph by Pictorial Agency.

TREES AT GRAY'S INN.

sad grey waste; and not all of the birds pass on: year by year the ring-doves come back to the Bank of England, not to draw their April dividends, but to build again their love nest in the old lime tree that leans across the Bank's garden.

This place is surely the unique example of the *hortus inclusus*—"a garden walled round," indeed, with walls ten miles thick. Strange that the centre of this world-mart, the inner sanctum of the Temple of Mammon itself, should be—a garden; that this city of money-makers should bear in its heart of hearts this tender green spot. A little quiet nook where mornings are fresh and dewy, where flowers bloom, living ropes of creepers festoon the walls, and flickering lights and shadows dapple the ground; where the music of rustling leaves, and the sweet odour of blossoms, are shaken from drooping boughs, and the ripple of falling water mingles with the cooing of the dove; and where the Bank clerks may beguile the long summer afternoons by watching from the windows the mother bird, as, "with fond endearments," she teaches her fluttering young ones the use of their wings.

A restful noonday haunt is the Tower, with its surrounding gardens; much frequented of working men, who sit at ease and smoke after-dinner tobacco. The sparrows would seem, by force of constant association, to have adopted human modes of life, and to strictly observe the dinner-hour leisure. However urgent may be the season's duties—nest building, feeding and educating the young, or what not—the sparrows always seem to be given over to idleness at this time of day; picking up, none too eagerly, stray crumbs, lazily trimming feathers, or, more commonly, simply lounging.

The gardens are pleasantly original in design and cultivation: the conventional order, lawn, flower bed, shrubbery and gravel, is confined to the private garden of Trinity Square—where may be seen, by the by, the very largest trees of the City. For the rest there is a steep bank garden on the north and west sides of the buildings, with an unusually varied and thriving array of trees; the ash, so rare in London, wych and common elms, sycamores and flowering cherries, with black poplars that atone for their ungainliness by their great size; much homely underwood, elder, lilac and privet, and

annual and perennial flowers, self-sown; and, not less welcome, some of those well-known familiar weeds that push with such an easy confidence into the most exclusive garden circles.

Still more agreeable, perhaps, are the moat gardens on the south side, between the buildings and the river, for these are cultivated in the country or vegetable-cum-flower-border style. Lozenge-shaped beds, edged with irregular tiles, or bits of old coping-stone, and filled with an irregular setting of old-fashioned flowers—larkspurs, wallflowers, and tulips, pæonies and stocks, cabbage roses, madonna lilies and hollyhocks—with a hedge, and paths innocent of gravel, and growing little bunches of grass on their own account; whilst close by may be a heap of well-dried manure, a rhubarb bed, and a series of thriving plots of parsnips, cabbages and all manner of "garden stuff," with a long screen of scarlet runners in their season. Butterflies hover about the cabbages, and a stray bee hums its way to or from the flower borders. Perhaps there may be a scent of broad beans in flower; and I can well fancy the dock labourer, lately from the country, meditatively regarding these matters through the smoke of his pipe, and wondering whether, after all, life had been so very bad back there in ——shire.

Pigeons sit in a row upon Traitor's Gate; and the old grey masonry, trailed over with vines, wistaria, and virginia creeper, forms a picture of mellow and peaceful age. Time and change have worked their beneficent will, subduing the defiant strength of the fortress, and the cruelty of the prison, and turning the field of blood into a garden.

Moving westward, one passes through Seething Lane and Hart Street, a region given over to the immortal memory of Mr. Pepys. There is the very gateway by which he was wont to enter the old Navy Yard; but one glances in vain now into the back regions for any green spot as a reminder of the garden—the garden where Mr. Pepys buried his money in the time of the Fire, and where afterwards he raked the grass and sifted the mould in the dead of night to find it again.

Of the many trees and greens of the Central City, one can only speak in passing. There is St. Michael's Alley, where I once saw, of all strange City sights, a haymaking—regular swathes cut with a scythe, and then turned and

Photograph by Pictorial Agency.

TREES AT THE TOWER OF LONDON.

Photograph by Pictorial Agency.

CHARTERHOUSE GARDENS.

tedded, and, for aught I know, stacked. It must be admitted, however, that I never saw the rick.

Most of the trees owe their preservation to their connection with the Church; they have "taken sanctuary" in the churchyards. Eminent amongst these is Wordsworth's Wood Street Plane, that used, before the devastating saw was laid to its branches, to stretch its hands out over the two little dusty houses "erected at ye sole costs and charges of St. Peters, Cheape: Ao. Dni. 1687," and fill a gap in the Cheapside buildings with green leaves. Stationers' Hall Court is a blank and stony place, but how is it transformed in summer by the lofty tree which roofs it in with green!

Close at hand lies the cloistral seclusion of Amen Court, where decorous old houses are draped with creepers, and where the grass seems younger and greener for the Cathedral sobriety all around. The largest tree, though apparently healthy, leans and droops with a languorous grace; and I love a leaning tree, one which, following not too hardly the strenuous *ad astra*, chooses to love the world, the green earth which is its mother and ours, and will stoop to listen to the whisper of the grass, and to toy with the lowly flowers of the field.

The charm of monastic calm possesses still the old garden of the Charterhouse; the garden which has witnessed many years of peace, and one of bitter tragedy. The walls are crumbling as old walls should crumble, but against them "the fig tree puts forth her green leaves, and the vines give a good smell." Old mulberry trees are there, and young walnuts—proper ornaments for ancient and courtly places; and a lovely sward, that makes a smooth green coverlet for the narrow beds of Priors and Canons long asleep.

Londoners are proverbially careless of the sights of London, and because the trees are always with us we hardly look at them, and the unspeakable debt which is owed to the plane, as the tree of London, is rarely acknowledged, nor any general meed of admiration paid to its serviceable grace. Some, indeed, there are who depreciate this good friend and citizen; who call it ungainly, coarse and "weedy"; who make ungracious comparisons, and refer to its invaluable characteristic of bark shedding as an untidy habit. Those who thus disparage the plane have surely failed to notice some of its special and

exclusive beauties; as, for instance, the peculiarly rich and elegant effect seen in the budding season of the tree, when last year's tassels, the swelling leaf buds, and the tiny velvet balls of the new blooms thickly stud the crooked twigs, showing an exquisite fretwork against the April sky. Neither do they know the plane in its proper environment of the country, enjoying pure air, sufficient space, and a generous soil.

I have seen on the banks of the Mole a plane tree that seemed too good for this world; such an one rather as might flourish by the waters of some fabled Holy City, bearing miraculous fruits and healing leaves. Trunk, branches, and foliage were all tinged with gold, as though perpetual sunshine were upon it. There are plane trees, too, of almost equal beauty at Moor Park, just outside Stella Cottage. Likely enough Stella and the trees were young and gay together.

Most of the City trees are cared for, and in their measure may be said to thrive; but not all. Hidden away in dark sunless courts, stunted and misgrown for lack of space and light, encumbered by their own dead branches, fouled with smoke and dust, they huddle round the grimy walls of the old church, if church be left—sometimes a tower only, or a warehouse that has usurped the church's place; with both feet in the graves of London's forgotten dead, these sorry fugitives still make a show of life, and have their time of budding and leafage, and at their worst can give a little grace even to the uncomeliness of a London court.

These are the weaker brethren; and the stronger and happier are not far to seek. But to my mind there is something of pathos in the life of all City trees, divorced as they are from all the conditions necessary to arboreal well-being; for a tree planted in the City is already condemned to an untimely death. It may be an exaggerated fancy, but when I look at these brave doomed ones, I am sometimes reminded of the gladiators of old Rome. For our pleasure are they placed in the deadly arena, and gallantly do they bear themselves in the face of day; but in the quiet of early morning, or at night when the moon shines and fresh breezes stray even into City streets

BANK OF ENGLAND FOUNTAIN.

and courts, I can fancy the trees, with bowing crests and waving arms, murmuring their mournful greeting, *Ave! Ave! Morituri te salutant!*

But there is no need to close upon this subdued note. The trees are not all dead yet, and in these days of parks and gardens, when not only do men seem alive to the value of open spaces as "lungs," but also have a tender and civilised regard for things beautiful and venerable; now, when so much of our talk is of forestry, we may well hope that for trees as well as men there is a good time coming. I have never seen better-shaped and healthier saplings than the young mulberries of Fountain Court, nor do the older trees that shadow that memory-haunted spot show any signs of diminished strength. Daily each of the Embankment planes stretches its fingers a little nearer towards its sister tree. Many of us may see them all join hands and make continuous bands of green along the noble street. Our grandchildren may perhaps see the branches meeting across the way.

Photograph by Pictorial Agency.

FINSBURY CIRCUS.

Of these trees, and of the Temple Gardens close by, we have had no space to write, nor of those of the other Inns of Court. We have passed by St. Paul's Churchyard, and the trees that cluster round the burial place of Milton; and the avenue at St. Botolph's, Bishopsgate, and many another spot where grass springs and trees put forth their leaves for the perpetual pleasure and refreshment of dwellers in London.

ARTHUR SCAMMELL.

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